Operating Instructions

TDR sensor for continuous level and interface measurement of liquids

VEGAFLEX 81

Modbus and Levelmaster protocol

Coax probe

Document ID: 42283

Contents

1 About this document
- 1.1 Function ... 4
- 1.2 Target group ... 4
- 1.3 Symbolism used ... 4

2 For your safety
- 2.1 Authorised personnel ... 5
- 2.2 Appropriate use ... 5
- 2.3 Warning about incorrect use ... 5
- 2.4 General safety instructions ... 5
- 2.5 CE conformity ... 5
- 2.6 NAMUR recommendations ... 6
- 2.7 Environmental instructions ... 6

3 Product description
- 3.1 Configuration ... 7
- 3.2 Principle of operation ... 8
- 3.3 Packaging, transport and storage ... 10
- 3.4 Accessories and replacement parts ... 10

4 Mounting
- 4.1 General instructions ... 13
- 4.2 Instructions for installation ... 13

5 Connecting to power supply
- 5.1 Preparing the connection ... 16
- 5.2 Connecting ... 16
- 5.3 Wiring plan, double chamber housing ... 18
- 5.4 Switch-on phase ... 19

6 Set up with the indicating and adjustment module
- 6.1 Adjustment volume ... 20
- 6.2 Insert indicating and adjustment module ... 20
- 6.3 Adjustment system ... 21
- 6.4 Parameter adjustment ... 21
- 6.5 Saving the parameter adjustment data ... 38

7 Setting up sensor and Modbus interface with PACTware
- 7.1 Connect the PC ... 39
- 7.2 Parameter adjustment with PACTware ... 40
- 7.3 Set up with the quick setup ... 41
- 7.4 Saving the parameter adjustment data ... 46

8 Set up with other systems
- 8.1 DD adjustment programs ... 47
- 8.2 Communicator 375, 475 ... 47

9 Diagnostics and service
- 9.1 Maintenance ... 48
- 9.2 Diagnosis memory ... 48
- 9.3 Status messages ... 49
- 9.4 Rectify faults ... 53
- 9.5 Exchanging the electronics module ... 56

42283-EN-121112

9.6 Software update 56
9.7 How to proceed in case of repair 57

10 Dismounting

10.1 Dismounting steps 58
10.2 Disposal 58

11 Supplement

11.1 Technical data 59
11.2 Basics Modbus 66
11.3 Modbus register 67
11.4 Modbus RTU commands 70
11.5 Levelmaster commands 73
11.6 Configuration of typical Modbus hosts 76
11.7 Dimensions 80

Safety instructions for Ex areas

Please note the Ex-specific safety information for installation and operation in Ex areas. These safety instructions are part of the operating instructions manual and come with the Ex-approved instruments.

Editing status: 2012-11-06

42283-EN-121112

1 About this document

1.1 Function

This operating instructions manual provides all the information you need for mounting, connection and setup as well as important instructions for maintenance and fault rectification. Please read this information before putting the instrument into operation and keep this manual accessible in the immediate vicinity of the device.

1.2 Target group

This operating instructions manual is directed to trained qualified personnel. The contents of this manual should be made available to these personnel and put into practice by them.

1.3 Symbolism used

Information, tip, note
This symbol indicates helpful additional information.

Caution: If this warning is ignored, faults or malfunctions can result.

Warning: If this warning is ignored, injury to persons and/or serious damage to the instrument can result.

Danger: If this warning is ignored, serious injury to persons and/or destruction of the instrument can result.

Ex applications
This symbol indicates special instructions for Ex applications.

- **List**
  The dot set in front indicates a list with no implied sequence.

→ **Action**
This arrow indicates a single action.

1 **Sequence**
Numbers set in front indicate successive steps in a procedure.

Battery disposal
This symbol indicates special information about the disposal of batteries and accumulators.

42283-EN-121112

2 For your safety

2.1 Authorised personnel

All operations described in this operating instructions manual must be carried out only by trained specialist personnel authorised by the plant operator.

During work on and with the device the required personal protective equipment must always be worn.

2.2 Appropriate use

VEGAFLEX 81 is a sensor for continuous level measurement.

You can find detailed information on the application range in chapter "*Product description*".

Operational reliability is ensured only if the instrument is properly used according to the specifications in the operating instructions manual as well as possible supplementary instructions.

2.3 Warning about incorrect use

Inappropriate or incorrect use of the instrument can give rise to application-specific hazards, e.g. vessel overfill or damage to system components through incorrect mounting or adjustment.

2.4 General safety instructions

This is a state-of-the-art instrument complying with all prevailing regulations and guidelines. The instrument must only be operated in a technically flawless and reliable condition. The operator is responsible for the trouble-free operation of the instrument.

During the entire duration of use, the user is obliged to determine the compliance of the necessary occupational safety measures with the current valid rules and regulations and also take note of new regulations.

The safety instructions in this operating instructions manual, the national installation standards as well as the valid safety regulations and accident prevention rules must be observed by the user.

For safety and warranty reasons, any invasive work on the device beyond that described in the operating instructions manual may be carried out only by personnel authorised by the manufacturer. Arbitrary conversions or modifications are explicitly forbidden.

The safety approval markings and safety tips on the device must also be observed.

2.5 CE conformity

The device fulfills the legal requirements of the applicable EC guidelines. By affixing the CE marking, we confirm successful testing of the product.

You can find the conformity certificate in the download section of our homepage.

42283-EN-121112

The instrument is designed for use in an industrial environment. Nevertheless, electromagnetic interference from electrical conductors and radiated emissions must be taken into account, as is usual with a class A instrument according to EN 61326-1. If the instrument is used in a different environment, its electromagnetic compatibility with other devices must be ensured by suitable measures.

2.6 NAMUR recommendations

NAMUR is the automation technology user association in the process industry in Germany. The published NAMUR recommendations are accepted as the standard in field instrumentation.

The device fulfills the requirements of the following NAMUR recommendations:

- NE 21 – Electromagnetic compatibility of equipment
- NE 43 – Signal level for malfunction information from measuring transducers
- NE 53 – Compatibility of field devices and indicating/adjustment components
- NE 107 - Self-monitoring and diagnosis of field devices

For further information see www.namur.de.

2.7 Environmental instructions

Protection of the environment is one of our most important duties. That is why we have introduced an environment management system with the goal of continuously improving company environmental protection. The environment management system is certified according to DIN EN ISO 14001.

Please help us fulfil this obligation by observing the environmental instructions in this manual:

- Chapter "*Packaging, transport and storage*"
- Chapter "*Disposal*"

3 Product description

3.1 Configuration

Type label

The type label contains the most important data for identification and use of the instrument:

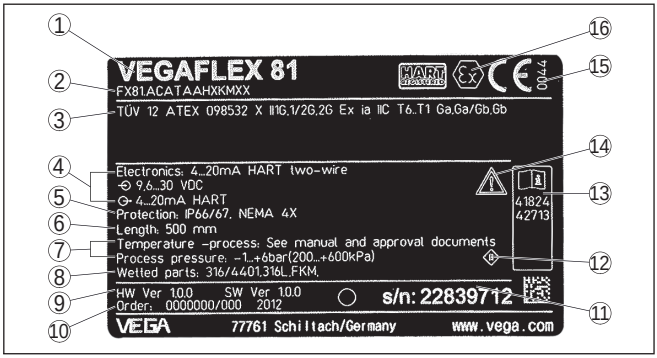


Fig. 1: Layout of the type label (example)

1 *Instrument type*
2 *Product code*
3 *Approvals*
4 *Power supply and signal output, electronics*
5 *Protection rating*
6 *Probe length*
7 *Process and ambient temperature, process pressure*
8 *Material, wetted parts*
9 *Hardware and software version*
10 *Order number*
11 *Serial number of the instrument*
12 *Symbol of the device protection class*
13 *ID numbers, instrument documentation*
14 *Note to observe the instrument documentation*
15 *Notified authority for CE marking*
16 *Approval directive*

Serial number

With the serial number of the instrument on the type label you have access to the following data on our homepage:

- Article number of the instrument (HTML)
- Delivery date (HTML)
- Order-specific instrument features (HTML)
- Operating instructions at the time of shipment (PDF)
- Order-specific sensor data for an electronics exchange (XML)
- Test certificate "Measuring Accuracy" (PDF)

For this purpose, move to www.vega.com and "*VEGA Tools*".

Electronics design

The instrument contains two different electronics in its housing chambers:

- The Modbus electronics for power supply and communication with the Modbus-RTU
- The sensor electronics for the actual measuring tasks

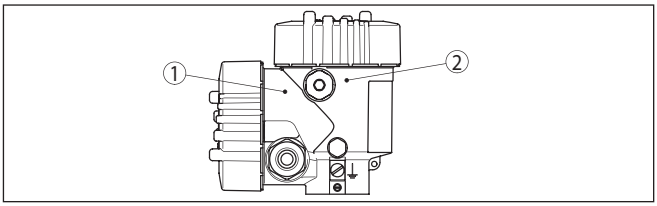


Fig. 2: Position of Modbus and sensor electronics

1 Modbus electronics
2 Sensor electronics

Scope of this operating instructions manual

This operating instructions manual applies to the following instrument versions:

- Hardware from 1.0.0
- Software from 1.0.0

Versions

The instrument can be supplied in two different electronics versions. Each electronics version can be identified via the product code on the type label as well as on the electronics.

- Standard electronics with supply voltage 90 … 253 V AC; 50/60 Hz: Type FX80B.-
- Standard electronics with supply voltage 9.6 … 48 V DC; 20 … 42 V AC: Type FX80I.-

Scope of delivery

The scope of delivery encompasses:

- Sensor
- Documentation
  - this operating instructions manual
  - Test certificate measuring accuracy (optional)
  - Operating instructions manual "*Indicating and adjustment module*" (optional)
  - Supplementary instructions "*GSM/GPRS radio module*" (optional)
  - Supplementary instructions manual "*Heating for indicating and adjustment module*" (optional)
  - Supplementary instructions manual "*Plug connector for continuously measuring sensors*" (optional)
  - Ex-specific "*Safety instructions*" (with Ex versions)
  - CE declarations of conformity
  - if necessary, further certificates

3.2 Principle of operation

Application area

The VEGAFLEX 81 is a level sensor with coax probe for continuous level or interface measurement, suitable for applications in liquids.

Functional principle - level measurement

High frequency microwave pulses are guided along a steel rope or a rod. Upon reaching the product surface, the microwave pulses are reflected. The running time is evaluated by the instrument and outputted as level.

42283-EN-121112

Functional principle - interface measurement

High frequency microwave impulses are guided along a steel cable or rod. When reaching the product surface, a part of the microwave impulses is reflected. The other part passes the upper product and is reflected a second time by the interface. The running times to the two product layers are processed by the instrument.

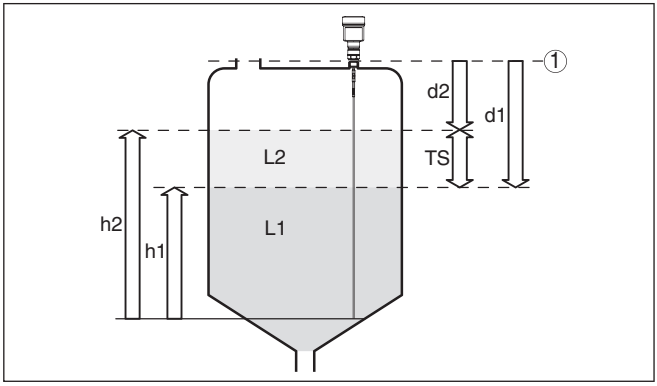


Fig. 3: Interface measurement

1 Sensor reference plane (seal surface of the process fitting)
d1 Distance to the interface (HART value 1)
d2 Distance to the level (HART value 3)
TS Thickness of the upper medium (d1 - d2)
h1 Height - Interface
h2 Height - Level
L1 Lower medium
L2 Upper medium

Prerequisites for interface measurement

Upper medium (L2)

- The upper medium must not be conductive
- The dielectric constant of the upper medium must be known (input required). Min. dielectric constant: rod version 1.6. You can find a list with the dielectric constants on our home page: www.vega.com
- The composition of the upper medium must be stable, no varying products or mixtures
- The upper medium must be homogeneous, no stratifications within the medium
- Min. thickness of the upper medium 50 mm (1.97 in)
- Clear separation from the lower medium, no emulsion phase, no mull layer
- If possible, no foam on the surface

Lower medium (L1)

- The dielectric figure must be 10 higher than the dielectric constant of the upper medium, preferably electrically conductive. Example: upper medium dielectric constant 2, lower medium at least dielectric constant 12.

Output signal

The instrument is always preset to the application "*Level measurement*".

For the interface measurement, you can select the requested output signal with the setup.

3.3 Packaging, transport and storage

Packaging

Your instrument was protected by packaging during transport. Its capacity to handle normal loads during transport is assured by a test according to DIN EN 24180.

The packaging of standard instruments consists of environment-friendly, recyclable cardboard. For special versions, PE foam or PE foil is also used. Dispose of the packaging material via specialised recycling companies.

Transport

Transport must be carried out under consideration of the notes on the transport packaging. Nonobservance of these instructions can cause damage to the device.

Transport inspection

The delivery must be checked for completeness and possible transit damage immediately at receipt. Ascertained transit damage or concealed defects must be appropriately dealt with.

Storage

Up to the time of installation, the packages must be left closed and stored according to the orientation and storage markings on the outside.

Unless otherwise indicated, the packages must be stored only under the following conditions:

- Not in the open
- Dry and dust free
- Not exposed to corrosive media
- Protected against solar radiation
- Avoiding mechanical shock and vibration

Storage and transport temperature

- Storage and transport temperature see chapter "*Supplement - Technical data - Ambient conditions*"
- Relative humidity 20 … 85 %

3.4 Accessories and replacement parts

Indicating and adjustment module

The indicating and adjustment module PLICSCOM is used for measured value indication, adjustment and diagnosis. It can be inserted into the sensor and removed at any time.

You can find further information in the operating instructions "*Indicating and adjustment module PLICSCOM*" (Document-ID 27835).

Interface adapter

The interface adapter VEGACONNECT enables the connection of communication-capable instruments to the USB interface of a PC. For parameter adjustment of these instruments, an adjustment software such as PACTware with VEGA-DTM is required.

You can find further information in the operating instructions "*Interface adapter VEGACONNECT*" (Document-ID 32628).

42283-EN-121112

External indicating and adjustment unit

VEGADIS 61 is an external indicating and adjustment unit for sensors with single chamber housing and Ex-d double chamber housing.

It is suitable for measured value indication and adjustment of plics® sensors and is connected to the sensor with a four-wire standard cable up to 50 m long.

You can find further information in the operating instructions "*VEGADIS 61*" (Document-ID 27720).

External indicating and adjustment unit with HART protocol

VEGADIS 62 is suitable for measured value indication and adjustment of sensors with HART protocol. It is looped into the 4 … 20 mA/HART signal cable.

You can find further information in the operating instructions "*VEGADIS 62*" (Document-ID 36469).

External radio unit

The PLICSMOBILE T61 is an external GSM/GPRS radio unit for transmission of measured values and for remote parameter adjustment of plics® sensors. The adjustment is carried out via PACTware/DTM by using the integrated USB connection.

You can find further information in the supplementary instructions "*PLICSMOBILE T61*" (Document-ID 36849).

Protective cover

The protective cover protects the sensor housing against soiling and intense heat from solar radiation.

You will find additional information in the supplementary instructions manual "*Protective cover*" (Document-ID 34296).

Flanges

Screwed flanges are available in different versions according to the following standards: DIN 2501, EN 1092-1, ANSI B 16.5, JIS B 2210-1984, GOST 12821-80.

You can find additional information in the supplementary instructions manual "*Flanges according to DIN-EN-ASME-JIS*" (Document-ID 31088).

Electronics module

The electronics module VEGAFLEX series 80 is a replacement part for TDR sensors of VEGAFLEX series 80. There is a different version available for each type of signal output.

You can find further information in the operating instructions manual "*Electronics module VEGAFLEX series 80*".

Electronics module, Modbus

The electronics module Modbus is a replacement part for TDR sensors of VEGAFLEX series 80.

You can find further information in the operating instructions manual "*Electronics module Modbus VEGAFLEX series 80*".

Indicating and adjustment module with heating

The indicating and adjustment module can be optionally replaced by an indicating and adjustment module with heating function.

You can hence use the indicating and adjustment module in a temperature range of -40 … 70 °C.

You can find further information in the operating instructions "*Indicating and adjustment module with heating*" (Document-ID 31708).

Rod extension

If you are using an instrument with rod version, you can extend the rod probe individually with rod extensions of different lengths.

The following lengths are available:

- 100 mm
- 200 mm
- 500 mm
- 1000 mm

You can find further information in the operating instructions manual "*Rod extension VEGAFLEX series 80*".

Spacer

If you mount the VEGAFLEX 81 in a bypass tube or standpipe, you have to avoid contact to the bypass tube by using a spacer at the probe end.

You can find further information in the operating instructions manual "*Bypass tube VEGAPASS 81*".

4 Mounting

4.1 General instructions

Screwing in

With instruments with threaded process fitting, suitable tools must be applied for tightening the hexagon.

Warning:
The housing must not be used to screw the instrument in! Applying tightening force can damage internal parts of the housing.

Moisture

Use the recommended cables (see chapter "*Connecting to power supply*") and tighten the cable gland.

You can give your instrument additional protection against moisture penetration by leading the connection cable downward in front of the cable entry. Rain and condensation water can thus drain off. This applies mainly to outdoor mounting as well as installation in areas where high humidity is expected (e.g. through cleaning processes) or on cooled or heated vessels.

Protective caps

In the case of instrument housings with self-sealing NPT threads, it is not possible to have the cable entries screwed in at the factory. The openings for the cable glands are therefore covered with red protective caps as transport protection.

Prior to setup you have to replace these protective caps with approved cable glands or close the openings with suitable blind plugs.

The suitable cable glands and blind plugs come with the instrument.

Suitability for the process conditions

Make sure that all parts of the instrument exposed to the process, in particular the active measuring component, process seal and process fitting, are suitable for the existing process conditions. These include above all the process pressure, process temperature as well as the chemical properties of the medium.

You can find the specifications in chapter "*Technical data*" and on the type label.

4.2 Instructions for installation

Installation position

Mount VEGAFLEX 81 in such a way that the distance to vessel installations or to the vessel wall is at least 300 mm (12 in). In non-metallic vessels, the distance to the vessel wall should be at least 500 mm (19.7 in).

During operation, the probe must not touch any installations or the vessel wall. If necessary, fasten the probe end.

In vessels with conical bottom it can be advantageous to mount the sensor in the center of the vessel, as measurement is then nearly possible down to the lowest point of the bottom. Keep in mind that measurement down to the tip of the probe is probably not possible. The exact value of the min. distance (lower blocking distance) is stated in chapter "*Technical data*".

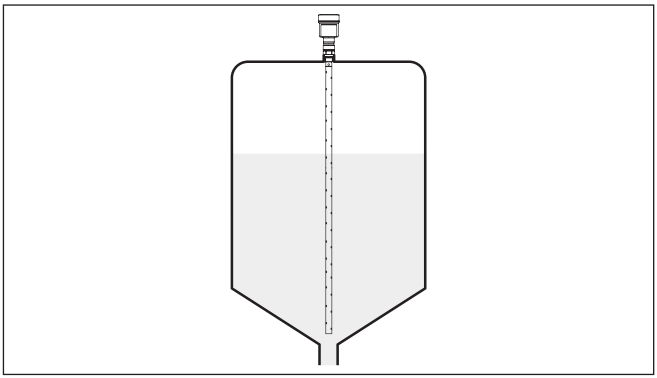


Fig. 4: Vessel with conical bottom

Welding work

Before beginning the welding work, remove the electronics module from the sensor. By doing this, you avoid damage to the electronics through inductive coupling.

Inflowing medium

Do not mount the instruments in or above the filling stream. Make sure that you detect the product surface, not the inflowing product.

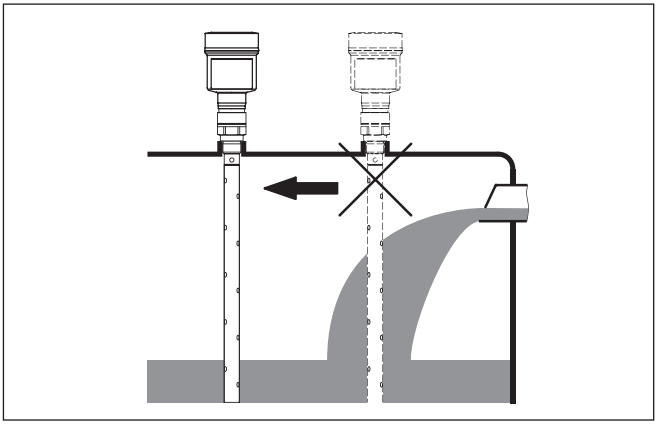


Fig. 5: Mounting of the sensor with inflowing medium

Measuring range

The reference plane for the measuring range of the sensors is the sealing surface of the thread or flange.

Keep in mind that a min. distance must be maintained below the reference plane and possibly also at the end of the probe - measurement in these areas is not possible (dead band). These dead bands are listed in chapter "*Technical data*". Keep in mind for the adjustment that the default setting for the measuring range refers to water.

Pressure

The process fitting must be sealed if there is gauge or low pressure in the vessel. Before use, check if the seal material is resistant against the measured product and the process temperature.

The max. permissible pressure is specified in chapter "*Technical data*" or on the type label of the sensor.

5 Connecting to power supply

5.1 Preparing the connection

Safety instructions

Always keep in mind the following safety instructions:

- Connect only in the complete absence of line voltage
- If overvoltage surges are expected, overvoltage arresters should be installed

Voltage supply

The instrument requires an operating voltage of 8 … 30 V DC. Operating voltage and digital bus signal are carried on separate two-wire connection cables.

Connection cable

The instrument is connected with standard two-wire, twisted cable suitable for RS 485. If electromagnetic interference is expected which is above the test values of EN 61326 for industrial areas, screened cable should be used.

Use cable with round cross-section. A cable outer diameter of 5 … 9 mm (0.2 … 0.35 in) ensures the seal effect of the cable gland. If you are using cable with a different diameter or cross-section, exchange the seal or use a suitable cable gland.

Make sure that the entire installation is carried out according to the Fieldbus specification. In particular, make sure that the bus is terminated with suitable terminating resistors.

Cable gland ½ NPT

With plastic housing, the NPT cable gland or the Conduit steel tube must be screwed without grease into the threaded insert.

Max. torque for all housings see chapter "*Technical data*".

Cable screening and grounding

With systems with potential equalisation, connect the cable screen directly to ground potential at the power supply unit, in the connection box and at the sensor. The screen in the sensor must be connected directly to the internal ground terminal. The ground terminal outside on the housing must be connected to the potential equalisation (low impedance).

In systems without potential equalisation, connect the cable screen directly to ground potential at the power supply unit and at the sensor. In the connection box or T-distributor, the screen of the short stub to the sensor must not be connected to ground potential or to another cable screen. The cable screens to the power supply unit and to the next distributor must be connected to each other and also connected to ground potential via a ceramic capacitor (e.g. 1 nF, 1500 V). The low frequency potential equalisation currents are thus suppressed, but the protective effect against high frequency interference signals remains.

5.2 Connecting

Connection technology

The voltage supply and signal output are connected via the spring-loaded terminals in the housing.

42283-EN-121112

The connection to the indicating and adjustment module or to the interface adapter is carried out via contact pins in the housing.

Information:
The terminal block is pluggable and can be removed from the electronics. To do this, lift the terminal block with a small screwdriver and pull it out. When inserting the terminal block again, you should hear it snap in.

Connection procedure

Proceed as follows:

1. Unscrew the housing cover
2. If an indicating and adjustment module is installed, remove it by turning it slightly to the left.
3. Loosen compression nut of the cable entry
4. Remove approx. 10 cm (4 in) of the cable mantle, strip approx. 1 cm (0.4 in) of insulation from the ends of the individual wires
5. Insert the cable into the sensor through the cable entry

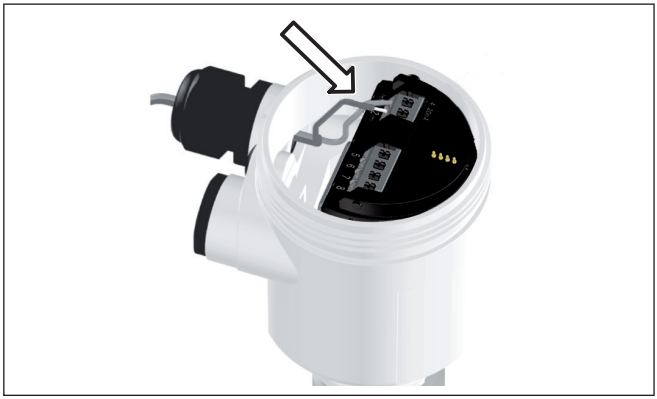


Fig. 6: Connection steps 5 and 6

6. Insert the wire ends into the terminals according to the wiring plan

Information:
Solid cores as well as flexible cores with cable end sleeves are inserted directly into the terminal openings. In case of flexible cores without end sleeves, press the terminal head with a small screwdriver; the terminal opening is freed. When the screwdriver is released, the terminal closes again.

You can find further information to the max. wire cross-section under "*Technical data/Electromechanical data*"

7. Check the hold of the wires in the terminals by lightly pulling on them
8. Connect the screen to the internal ground terminal, connect the outer ground terminal to potential equalisation
9. Tighten the compression nut of the cable entry. The seal ring must completely encircle the cable

10. Place probably existing indicating and adjustment module back on
11. Screw the housing cover back on

The electrical connection is hence finished.

5.3 Wiring plan, double chamber housing

Overview

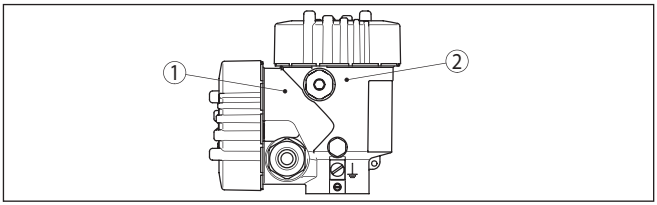


Fig. 7: Position of connection compartment (Modbus electronics) and electronics compartment (sensor electronics)

1 Connection compartment
2 Electronics compartment

Electronics compartment

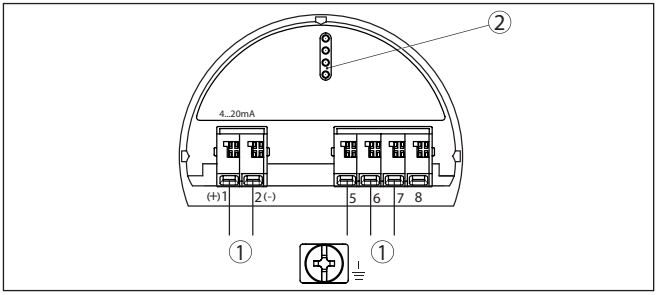


Fig. 8: Electronics compartment, double chamber housing

1 Internal connection to the connection compartment
2 For indicating and adjustment module or interface adapter

Information:
The connection of an external indicating and adjustment unit is not possible with this double chamber housing.

Connection compartment

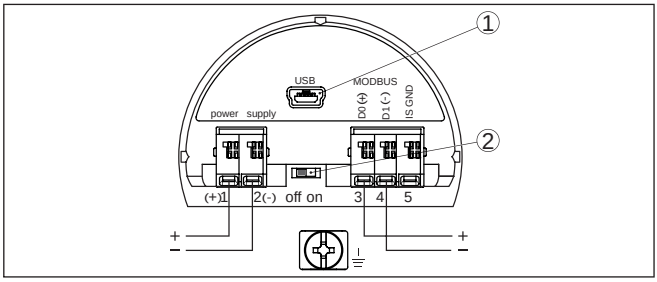


Fig. 9: Connection compartment

1 USB connection
2 Slide switch for integrated termination resistor (120 Ω)

Terminal	Function	Polarity
1	Voltage supply	+
2	Voltage supply	-
3	Modbus-Signal D0	+
4	Modbus-Signal D1	-
5	Function ground with installation according to CSA	

5.4 Switch-on phase

After connecting the instrument to power supply or after a voltage recurrence, the instrument carries out a self-check for approx. 30 s:

- Internal check of the electronics
- Indication of the instrument type, hardware and software version, measurement loop name on the display or PC
- Indication of the status message "*F 105 Determine measured value*" on the display or PC
- The output signal jumps to the set error current

As soon as a plausible measured value is found, the corresponding current is outputted to the signal cable. The value corresponds to the actual level as well as the settings already carried out, e.g. factory setting.

6 Set up with the indicating and adjustment module

6.1 Adjustment volume

The indicating and adjustment module is only used for parameter adjustment of the sensor, i.e. for adaptation to the measurement task.

The parameter adjustment of the Modbus interface is carried out via a PC with PACTware. You can find the procedure in chapter "*Set up sensor and Modbus interface with PACTware*".

6.2 Insert indicating and adjustment module

The indicating and adjustment module can be inserted into the sensor and removed any time. Four positions displaced by 90° can be selected. It is not necessary to interrupt the power supply.

Proceed as follows:

1. Unscrew the housing cover
2. Place the indicating and adjustment module in the requested position onto the electronics and turn to the right until it snaps in
3. Screw housing cover with inspection window tightly back on

Removal is carried out in reverse order.

The indicating and adjustment module is powered by the sensor, an additional connection is not necessary.

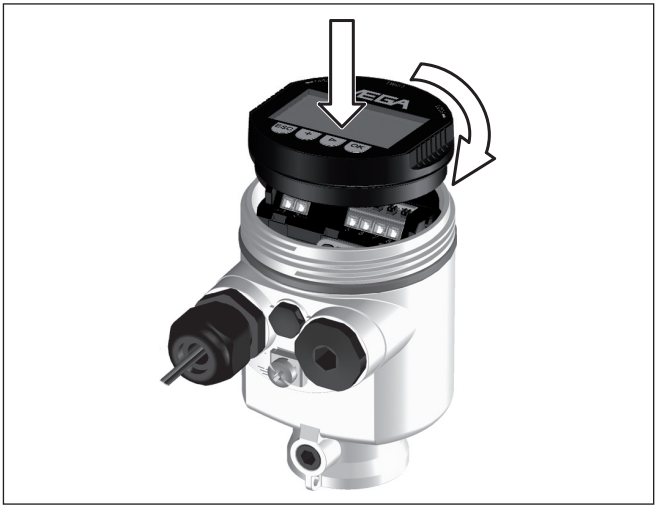


Fig. 10: Insertion of the indicating and adjustment module with single chamber housing

Note:
If you intend to retrofit the instrument with an indicating and adjustment module for continuous measured value indication, a higher cover with an inspection glass is required.

6.3 Adjustment system

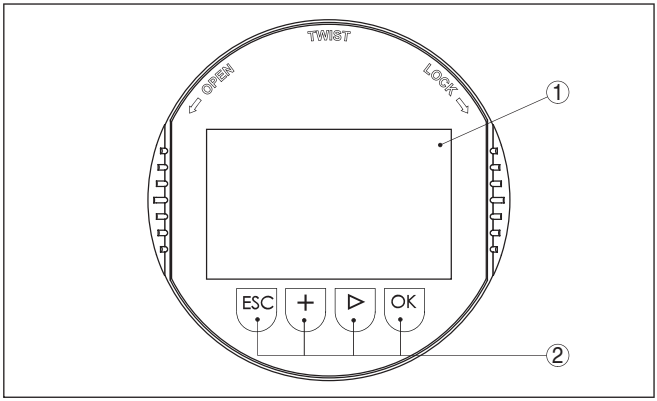


Fig. 11: Indicating and adjustment elements

1 LC display
2 Adjustment keys

Key functions

- ***[OK]*** key:
  - Move to the menu overview
  - Confirm selected menu
  - Edit parameter
  - Save value
- ***[->]*** key:
  - Presentation change measured value
  - Select list entry
  - Select editing position
- ***[+]*** key:
  - Change value of the parameter
- ***[ESC]*** key:
  - interrupt input
  - Jump to next higher menu

Adjustment system

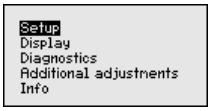
The sensor is adjusted via the four keys of the indicating and adjustment module. The LC display indicates the individual menu items. The functions of the individual keys are shown in the above illustration. Approx. 10 minutes after the last pressing of a key, an automatic reset to measured value indication is triggered. Any values not confirmed with ***[OK]*** will not be saved.

6.4 Parameter adjustment

Through the parameter adjustment the instrument is adapted to the application conditions. The parameter adjustment is carried out via an adjustment menu.

Main menu

The main menu is divided into five sections with the following functions:



Setup: Settings, for example to measurement loop name, medium, vessel, adjustment, signal output, device unit, false signal suppression, linearization curve

Display: Settings, e.g., for language, measured value display, lighting

Diagnosis: Information, e.g. on the instrument status, pointer, reliability, simulation, echo curve

Additional adjustments: Reset, date/time, reset, copying function

Info: Instrument name, hardware and software version, calibration date, instrument features

Note:
For optimum adjustment of the measurement, the individual submenu items in the main menu item "*Setup*" should be selected one after the other and provided with the correct parameters. If possible, go through the items in the given sequence.

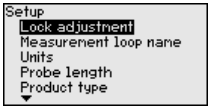
The procedure is described below.

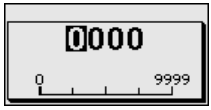
Lock/release setup/adjustment

In the menu item "*Block/allow adjustment*", you can protect the sensor parameters against unauthorized modification. The PIN is activated/deactivated permanently.

The following adjustment functions are possible without entering the PIN:

- Select menu items and show data
- Read data from the sensor into the indicating/adjustment module.





Caution:
With active PIN, the adjustment via PACTware/DTM as well as other systems is also blocked.

You can change the PIN number under "*Additional adjustments/PIN*".

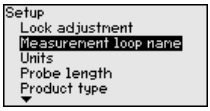
Setup/Measurement loop name

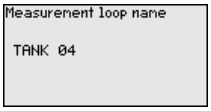
Here you can assign a suitable measurement loop name. Push the "***OK***" key to start the processing. With the "**+**" key you change the sign and with the "**->**" key you jump to the next position.

You can enter names with max. 19 characters. The character set comprises:

- Capital letters from A … Z
- Numbers from 0 … 9
- Special characters + - / _ blanks

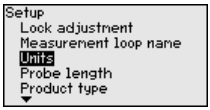
42283-EN-121112

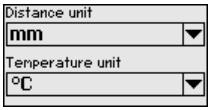




Setup/Units

In this menu item you select the distance unit and the temperature unit.

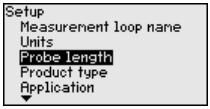


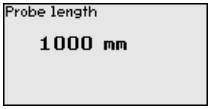


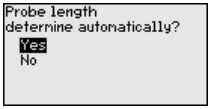
With the distance units you can choose between m, mm and ft and with the temperature units betwenn °C, °F and K.

Setup/Probe length

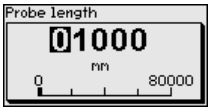
In this menu item you can enter the probe length or have the length determined automatically by the sensor system.





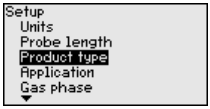


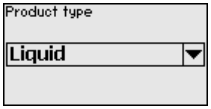
When choosing "*Yes*", then the probe length will be determined automatically. When choosing "*No*", you can enter the probe length manually.



Setup/Medium type

In this menu item, you can see which medium type the instrument is suitable for.





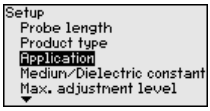
Setup/Application

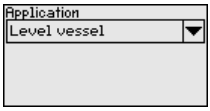
In this menu item, you can select the application. You can choose between level measurement and interface measurement. You can also choose between measurement in the vessel or in the bypass or standpipe.

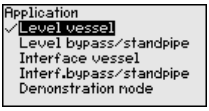
Note:

The selection of the application has a considerable influence on all other menu items. Keep in mind that as you continue with the parameter adjustment, individual menu items are only optionally available.

You have the possibility to choose the demonstration mode. This mode is suitable for test and demonstration purposes. In this mode, the sensor ignores the logic parameters of the application and reacts immediately to each change.



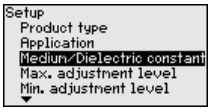


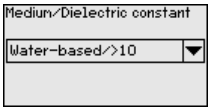


Setup/Medium, dielectric constant

In this menu item, you can define the medium type (product).

This menu item is only available if you have selected level measurement under the menu item "*Application*".





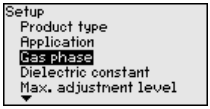
You can choose between the following medium types:

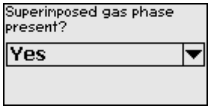
Dielectric constant	Type of medium	Examples
≥ 10	Water-based liquids	Acids, alcalis, water
> 3 … < 10	Chemical mixtures	Chlorobenzene, nitro lacquer, aniline, isocyanate, chloroform
≤ 3	Hydrocarbons	Solvents, oils, liquid gas

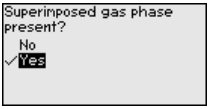
Setup/Gas phase

This menu item is only available, if you have chosen interface measurement under the menu item "*Application*". In this menu item you can enter if there is a superimposed gas phase in your application.

Only set the function to "*Yes*", if the gas phase is permanently present.

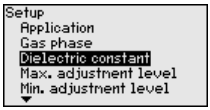


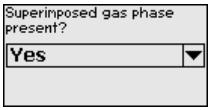


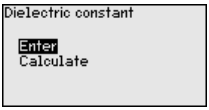


Setup/Dielectric constant

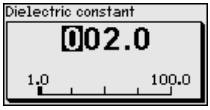
This menu item is only available if you have selected interface measurement under the menu item "*Application*". In this menu item you can choose the medium type of the upper medium.



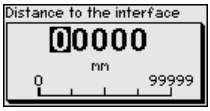




You can directly enter the dielectric constant of the upper medium

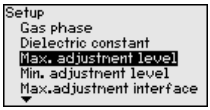


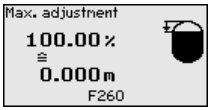
or have it determined by the instrument. You have to enter the measured distance to the interface.



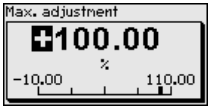
Setup/Max. adjustment - Level

In this menu item you can enter the max. adjustment for the level. This is the max. total level with interface measurement.

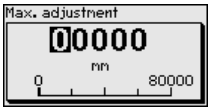




Adjust the requested percentage value with ***[+]*** and save with ***[OK]***.

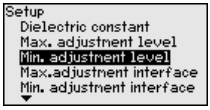


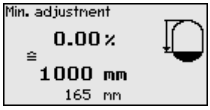
Enter the appropriate distance value in m (corresponding to the percentage value) for the full vessel. The distance refers to the sensor reference plane (seal surface of the process fitting). Keep in mind that the max. level must lie below the dead band.



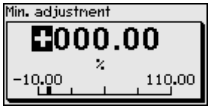
Setup/Min. adjustment - Level

In this menu item you can enter the min. adjustment for the level. This is the min. total level with interface measurement.

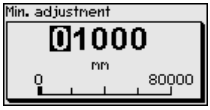




Adjust the requested percentage value with ***[+]*** and save with ***[OK]***.

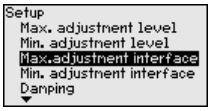


Enter the suitable distance value in m for the empty vessel (e.g. distance from the flange to the probe end) corresponding to the percentage value. The distance refers tot he sensor reference plane (seal surface of the process fitting).

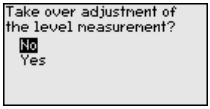


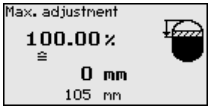
Setup/Max. adjustment - Interface

This menu item is only available if you have selected interface measurement under the menu item "*Application*".

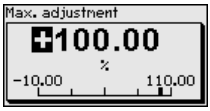


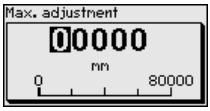
You can accept the adjustment of the level measurement also for the interface measurement. If you select "Yes", the actual setting will be displayed.





If you have selected "*No*", then you can enter the adjustment for the interface separately. Enter the requested percentage value.

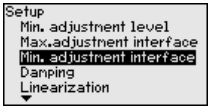


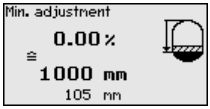


Enter the distance value in m for the full vessel suitable for the percentage value.

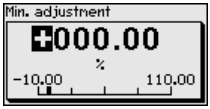
Setup/Min. adjustment - Interface

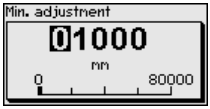
This menu item is only available if you have selected interface measurement under the menu item "*Application*". If you have selected "*Yes*" in the previous menu item (accept adjustment of the level measurement), then the actual setting will be displayed.





If you have selected "*Nein*", then you can enter the adjustment for the interface measurement separately.

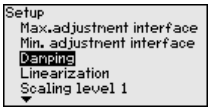




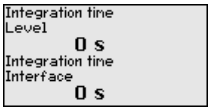
Enter the respective distance value in m for the empty vessel corresponding to the percentage value.

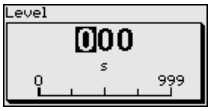
Setup/Damping

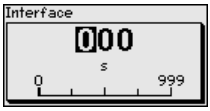
To damp process-dependent measured value fluctuations, you have to set an integration time of 0 … 999 s in this menu item.



If you have selected interface measurement under the menu item "*Application*", you can adjust the damping for the level and the interface separately.





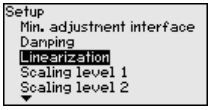


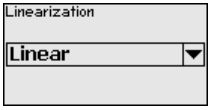
The default setting is a damping of 0 s.

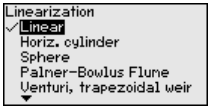
Setup/Linearization

A linearization is necessary for all vessels in which the vessel volume does not increase linearly with the level - e.g. in a horizontal cylindrical or spherical tank when the indication or output of the volume is required. Corresponding linearization curves are preprogrammed for these vessels. They represent the correlation between the level percentage and vessel volume.

The linearization applies to the measured value indication and the current output. By activating the appropriate curve, the volume percentage of the vessel is displayed correctly. If the volume should not be displayed in percent but e.g. in l or kg, a scaling can be also set in the menu item "*Display*".







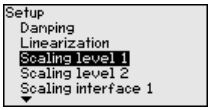
Caution:

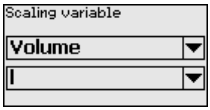
Note the following, if the respective sensor is used as part of an overfill protection system according to WHG:

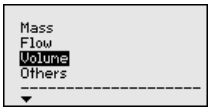
If a linearisation curve is selected, the measuring signal is no longer linearly proportional to the level. This must be taken into consideration by the user, particularly when setting the switching point on the level switch.

Setup/Scaling - Level 1

Since the scaling is very comprehensive, the scaling of the level value was divided into two menu items. In the menu item "*Level 1*" you define the scaling size and the scaling unit for the level value on the display, e.g. volume in l.

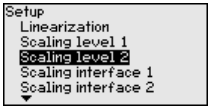


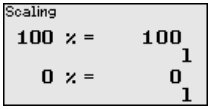




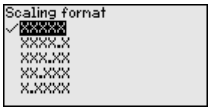
Setup/Scaling - Level 2

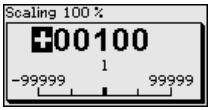
Since the scaling is very comprehensive, the scaling of the level value was divided into two menu items.

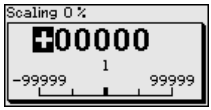




In menu item "*Level 2*" you define the scaling format on the display and the scaling of the level measured value for 0 % and 100 %.

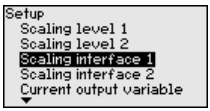




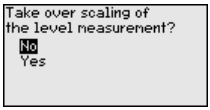


Setup/Scaling - Interface 1

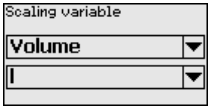
Since the scaling is very comprehensive, the scaling of the interface measured value was divided into two menu items. In the menu item "*Interface 1*" you define the scaling size and the scaling unit for the interface value on the display, e.g. volume in l.

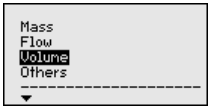


You can accept the scaling of the level measurement also for the interface measurement. If you select "*Yes*", the actual setting will be displayed.



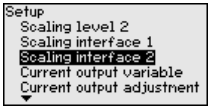
If you have selected "*No*", then you can enter the scaling for the interface separately.

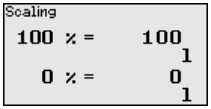




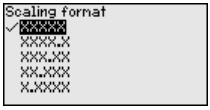
Setup/Scaling - Interface 2

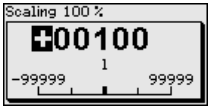
Since the scaling is very extensive, the scaling of the interface measured value was divided into two menu items.

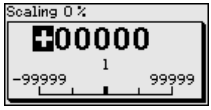




In menu item "*Interface 2*" you define the scaling format on the display and the scaling of the interface measured value for 0 % and 100 %.

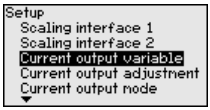


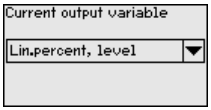


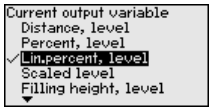


Setup/Current output - Size

In menu item"*Current output, size*" you determine which measured value the current output refers to.

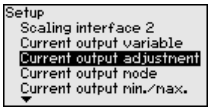


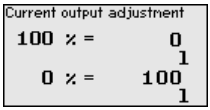


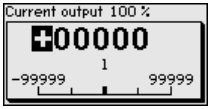


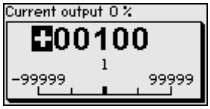
Setup/Current output - Adjustment

In menu item "*Current output, adjustment*" you can assign a respective measured value to the current output.



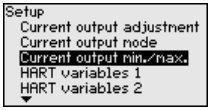


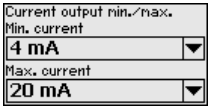


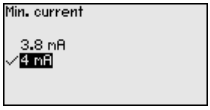


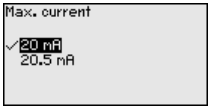
Setup/Current output Min./Max.

In the menu item "*Current output Min./Max.*", you determine the reaction of the current output during operation.







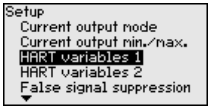


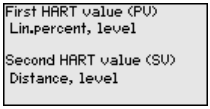
The default setting is min. current 3.8 mA and max. current 20.5 mA.

Setup/HART variables 1

Since the HART variables are very extensive, the indication was divided into two menu items. In the menu item "*HART variables 1*" you can have the first HART value PV (primary value) and the second HART value SV (second value) of the sensor displayed.

A change of the values is not possible in the indicating and adjustment module. To change these values, you have to use the adjustment software PACTware.

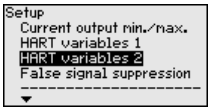


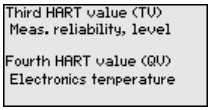


Setup/HART variables 2

Since the HART variables are very extensive, the indication was divided into two menu items. In the menu item "*HART variables 2*" you can have the third HART value TV (third value) and the fourth HART value QV (quarter value) of the sensor displayed.

A change of the values is not possible in the indicating and adjustment module. To change these values, you have to use the adjustment software PACTware.





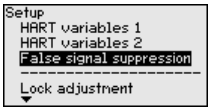
Setup/False signal suppression

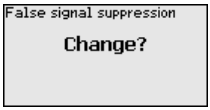
The following circumstances cause interfering reflections and can influence the measurement:

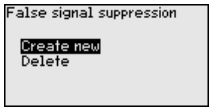
- High sockets
- Vessel installations such as struts

Note:
A false signal suppression detects, marks and saves these false signals so that they are no longer taken into account for the level and interface measurement. We generally recommend carrying out a false signal suppression to achieve the best possible accuracy. This should be done with the lowest possible level so that all potential interfering reflections can be detected.

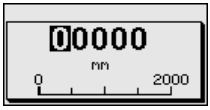
Proceed as follows:







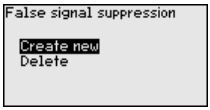
Enter the actual distance from the sensor to the product surface.



All interfering signals in this section are detected by the sensor and stored.

Note:
Check the distance to the product surface, because if an incorrect (too large) value is entered, the existing level will be saved as false signal. The filling level would then no longer be detectable in this area.

If a false signal suppression has already been created in the sensor, the following menu window appears when selecting "*False signal suppression*":

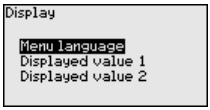


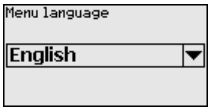
The instrument carries out an automatic false signal suppression as soon as the probe is uncovered.

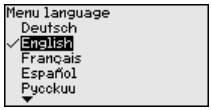
The menu item "*Delete*" is used to completely delete an already created false signal suppression. This is useful if the saved false signal suppression no longer matches the metrological conditions in the vessel.

Display/Menu language

This menu item enables the setting of the requested national language.



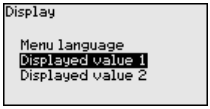


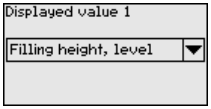


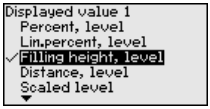
In the delivery status, the sensor is set to the ordered national language.

Display/Displayed value 1

In this menu item, you define the indication of the measured value on the display. You can display two different measured values. In this menu item, you define measured value 1.



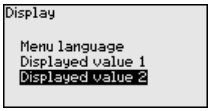


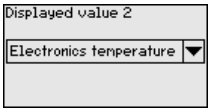


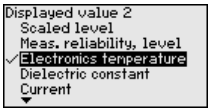
The default setting for the displayed value 1 is "*Filling height Level*".

Display/Displayed value 2

In this menu item, you define the indication of the measured value on the display. You can display two different measured values. In this menu item, you define measured value 2.



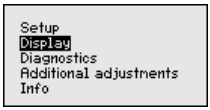


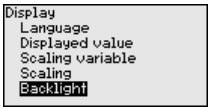


The default setting for the displayed value 2 is the electronics temperature.

Display/Backlight

The optionally integrated background lighting can be adjusted via the adjustment menu. The function depends on the height of the supply voltage, see "*Technical data*".

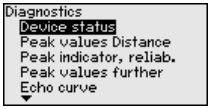


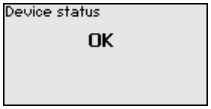


The lighting is switched off in the delivery status.

Diagnostics/Device status

In this menu item, the device status is displayed.

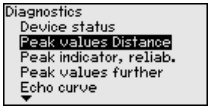


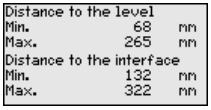


Diagnostics/Peak values - Distance

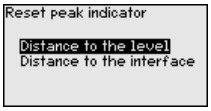
The respective min. and max. measured value is saved in the sensor. The two values are displayed in the menu item "*Peak values, distance*".

If you have selected interface measurement under the menu item "*Setup/Application*", then the peak values of the interface measurement are displayed in addition to the peak values of the level measurement.





In another window you can carry out a reset of the two peak values separately.

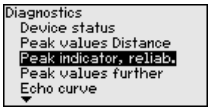


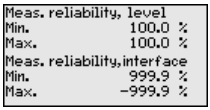
Diagnostics/Peak values - Measurement certainty

The respective min. and max. measured values are saved in the sensor. The two values are displayed in the menu item "*Peak values, measurement certainty*".

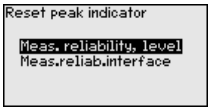
The measurement can be influenced by the process conditions. In this menu item, the measurement certainty of the level measurement is displayed as percentage value. The higher the value, the more reliable the measurement. Values > 90 % indicate reliable measurement.

If you have selected interface measurement under the menu item "*Setup/Application*", then the peak values of the interface measurement are displayed in addition to the peak values of the level measurement.





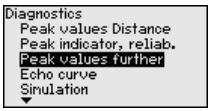
In another window you can carry out a reset of the two peak values separately.

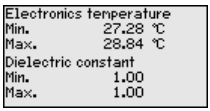


Diagnostics/Peak values - Further

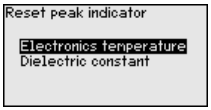
The respective min. and max. measured values are saved in the sensor. The values are displayed in the menu item "*Peak values - Additional*".

This menu item displays the peak values of the electronics temperature as well as the dielectric constant.



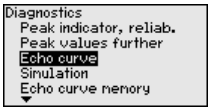


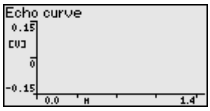
In another window you can carry out a reset of the two peak values separately.



Diagnostics/Echo curve

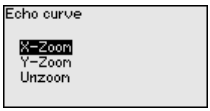
The menu item "*Echo curve*" shows the signal strength of the echoes over the measuring range in V. The signal strength enables an evaluation of the quality of the measurement.

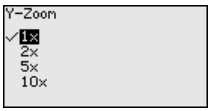




With the following functions you can zoom part sections of the echo curve.

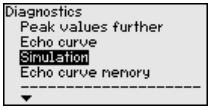
- "X-Zoom": Zoom function for the meas. distance
- "Y-Zoom": 1, 2, 5 and 10x signal magnification in "*V*"
- "Unzoom": Reset the presentation to the nominal measuring range with single magnification

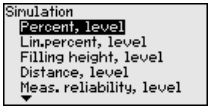




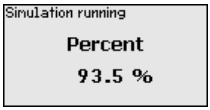
Diagnostics/Simulation

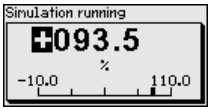
In this menu item you can simulate measured values via the current output. This allows the signal path to be tested, e.g. via downstream indicating instruments or the input card of the control system.





Select the requested simulation size and adjust the requested value.





Caution:
During simulation, the simulated value is outputted as 4 … 20 mA current value and digital HART signal.

Push the ***[ESC]*** key to interrupt the simulation.

Information:
The simulation is terminated automatically 60 minutes after the last key has been pushed.

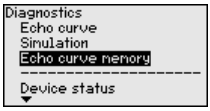
Diagnostics/Echo curve memory

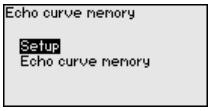
The function "*Echo curve memory*" enables storing echo curves of the measurement.

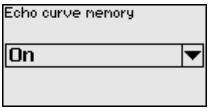
Under the sub-menu item "*Echo curve memory*" you can activate or deactivate the storing of the echo curve.

The parameters for recording the echo curve and the settings of the echo curve can be carried out in the adjustment software PACTware. With this menu item you can only start or stop the storing process.

With the adjustment software PACTware and the PC the high-resolution echo curve can be displayed and used later on to assess the quality of the measurement.

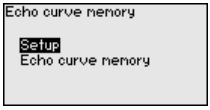


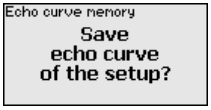




With the menu item "*Setup*" the echo curve it is possible to save at the time of setup. This is generally recommended; for using the Asset Management functions it is necessary. If possible, the curve should be saved with a low level in the vessel.

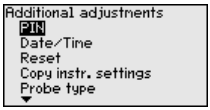
With this, you can detect signal changes over the operating time. With the adjustment software PACTware and the PC, the high-resolution echo curve can be displayed and used to compare the echo curve of the setup with the actual echo curve.

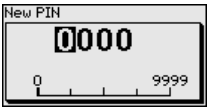




Additional adjustments/ PIN

Entering a 4-digit PIN protects the sensor data against unauthorized access and unintentional modification. In this menu item, the PIN is displayed or edited and changed. However, this menu item is only available if adjustment is enabled in the menu "*Lock/Release setup/ adjustment*".

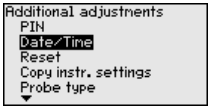


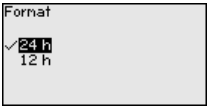


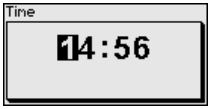
In delivery status, the PIN is "*0000*".

Additional adjustments/ Date time

In this menu item, the internal clock of the sensor is adjusted.

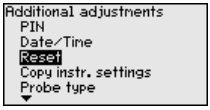


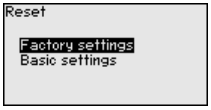




Additional adjustments - Reset

With a reset, certain parameter adjustments carried out by the user are reset.





The following reset functions are available:

Delivery status: Restoring the parameter settings at the time of shipment from the factory incl. the order-specific settings. A created false

signal suppression, user-programmable linearization curve as well as the measured value memory will be deleted.

Basic settings: Resetting the parameter settings incl. special and laboratory parameters to the default values of the respective instrument. A created false signal suppression, user programmable linearization curve as well as the measured value memory will be deleted.

The following table shows the default values of the instrument. Depending on the instrument version or application, all menu items may not be available or some may be differently assigned:

Menu	Menu item	Default value
Setup	Lock operation	Released
	Measurement loop name	Sensor
	Units	Distance unit: mm Temperature unit: °C
	Probe length	Length of the probe Ex factory
	Product type	Liquid
	Application	Level, vessel
	Medium, dielectric constant	Water-based, > 10
	Max. adjustment	0.000 m(d) - note blocking distances
	Min. adjustment	Probe length - take dead band into account
	Linearisation	Linear
	Damping	0.0 s
	Scaling size	Volume in l
	Current output - adjustment	0.00 lin %, 0 l 100.00 lin %, 100 l
	Current output - mode	Last measured value
	Current output - Min./Max.	Min. current 3.8 mA, max. current 20.5 mA
Display	Language	As set in the device
	Displayed value 1	Filling height, level
	Displayed value 2	Electronics temperature
	Backlight	Switched off
Additional adjustments	PIN	0000
	Probe type	Like order
	HART mode	Address 0 - Standard

Additional adjustments/ Copy instrument settings

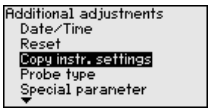
The instrument settings are copied with this function. The following functions are available:

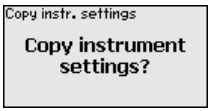
- read from sensor: Read data from sensor and store into the indicating and adjustment module

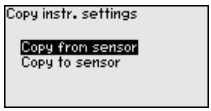
- write into sensor: Store data from the indicating and adjustment module back to the sensor

The following data or settings for adjustment of the indicating and adjustment module are saved:

- All data of the menu "*Setup*" and "*Display*"
- In the menu "*Additional adjustments*" the items "*Reset, Date/Time*"
- Special parameters





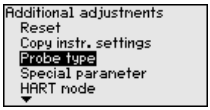


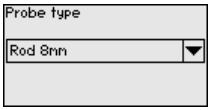
The copied data are permanently saved in an EEPROM memory in the indicating and adjustment module and remain there even in case of power failure. From there, they can be written into one or more sensors or kept as backup for a possible electronics exchange.

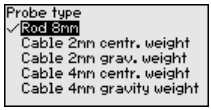
Note:
Before the data are stored in the sensor, a check is carried out to determine if the data fit the sensor. If the data do not fit, a fault signal is triggered or the function is blocked. When data are being written into the sensor, the display shows which instrument type the data originate from and which TAG-no. this sensor had.

Additional adjustments/ Probe type

In this menu item you can select the type and size of your probe from a list of all possible probes. This is necessary to adapt the electronics optimally to the probe.



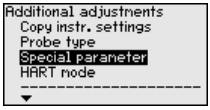


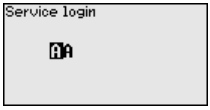


Additional adjustments/ Special parameters

In this menu item you gain access to the protected area where you can enter special parameters. In exceptional cases, individual parameters can be modified in order to adapt the sensor to special requirements.

Change the settings of the special parameters only after having contacted our service staff.





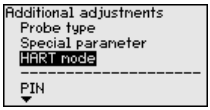
Additional adjustments/ HART mode

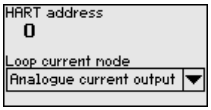
The sensor offers the HART modes "*Analogue current output*" and "*Fix current (4 mA)*". In this menu item you determine the HART mode and enter the address with Multidrop mode.

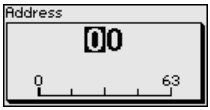
In the mode "*Fix current output*" up to 63 sensors can be operated on one two-wire cable (Multidrop operation). An address between 0 and 63 must be assigned to each sensor.

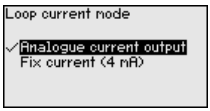
If you select the function "*Analogue current output*" and also enter an address number, you can output a 4 … 20 mA signal in Multidrop mode.

In mode "*Fix current (4 mA)*" a fix 4 mA signal is outputted independent from the actual level.





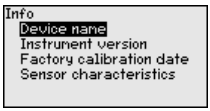


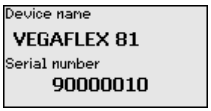


The default setting is "*Analogue current output*" and the address 00.

Info/Instrument name

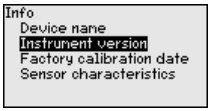
In this menu, you read out the instrument name and the instrument serial number:

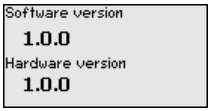




Info/Instrument version

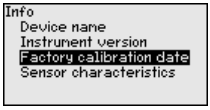
In this menu item, the hardware and software version of the sensor is displayed.





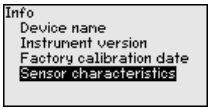
Info/Factory calibration date

In this menu item, the date of factory calibration of the sensor as well as the date of the last change of sensor parameters are displayed via the indicating and adjustment module or via the PC.



Info/Sensor characteristics

In this menu item, the features of the sensor such as approval, process fitting, seal, measuring range, electronics, housing and others are displayed.



6.5 Saving the parameter adjustment data

We recommended noting the adjusted data, e.g. in this operating instructions manual, and archiving them afterwards. They are thus available for multiple use or service purposes.

If the instrument is equipped with an indicating and adjustment module, the data in the sensor can be saved in the indicating and adjustment module. The procedure is described in the operating instructions manual "*Indicating and adjustment module*" in the menu item "*Copy sensor data*". The data remain there permanently even if the sensor power supply fails.

The following data or settings for adjustment of the indicating and adjustment module are saved:

- All data of the menu "*Setup*" and "*Display*"
- In the menu "*Additional adjustments*" the items "*Sensor-specific units, temperature unit and linearization*"
- The values of the user programmable linearisation curve

The function can also be used to transfer settings from one instrument to another instrument of the same type. If it is necessary to exchange a sensor, the indicating and adjustment module is inserted into the replacement instrument and the data are likewise written into the sensor via the menu item "*Copy sensor data*".

7 Setting up sensor and Modbus interface with PACTware

7.1 Connect the PC

To the sensor electronics

The connection of the PC to the sensor electronics is carried out via the interface adapter VEGACONNECT 4.

Scope of the parameter adjustment:

- Sensor electronics

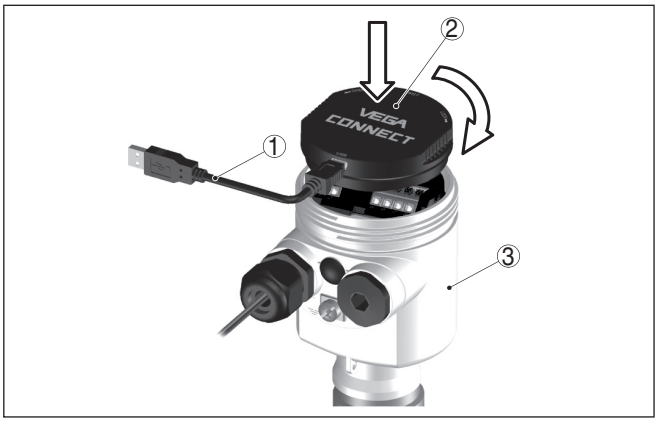


Fig. 12: Connection of the PC directly to the sensor via the interface adapter

1 USB cable to the PC
2 Interface adapter VEGACONNECT 4
3 Sensor

To the Modbus electronics

The connection of the PC to the Modbus electronics is carried out via a USB cable.

Scope of the parameter adjustment:

- Sensor electronics
- Modbus electronics

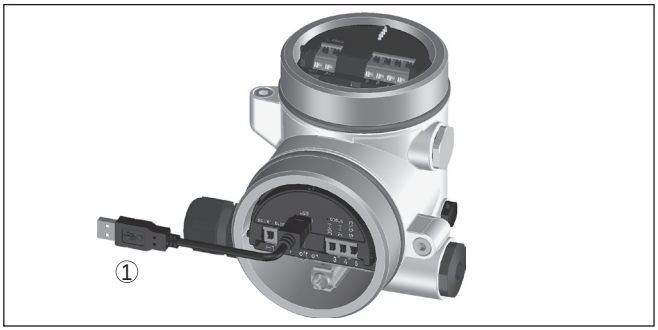


Fig. 13: Connecting the PC via USB to the Modbus electronics

1 USB cable to the PC

To the RS 485 cable

The connection of the PC to the RS 485 cable is carried out via a standard interface adapter RS 485/USB.

Scope of the parameter adjustment:

- Sensor electronics
- Modbus electronics

Information:
For the parameter adjustment it is absolutely necessary to separate the connection to the RTU.

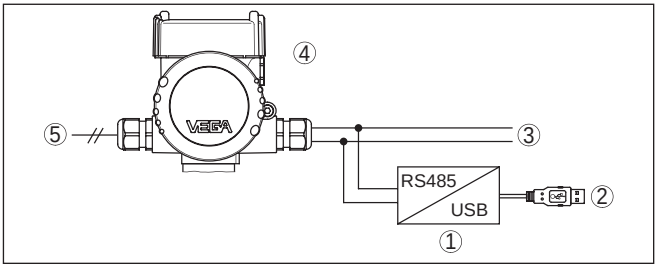


Fig. 14: Connection of the PC via the interface adapter to the RS 485 cable

1 Interface adapter RS 485/USB
2 USB cable to the PC
3 RS 485 cable
4 Sensor
5 Voltage supply

7.2 Parameter adjustment with PACTware

Prerequisites

For parameter adjustment of the sensor via a Windows PC, the configuration software PACTware and a suitable instrument driver (DTM) according to FDT standard are required. The up-to-date PACTware version as well as all available DTMs are compiled in a DTM Collection. The DTMs can also be integrated into other frame applications according to FDT standard.

Note:
To ensure that all instrument functions are supported, you should always use the latest DTM Collection. Furthermore, not all described functions are included in older firmware versions. You can download the latest instrument software from our homepage. A description of the update procedure is also available in the Internet.

Further setup steps are described in the operating instructions manual "*DTM Collection/PACTware*" attached to each DTM Collection and which can also be downloaded from the Internet. Detailed descriptions are available in the online help of PACTware and the DTMs.

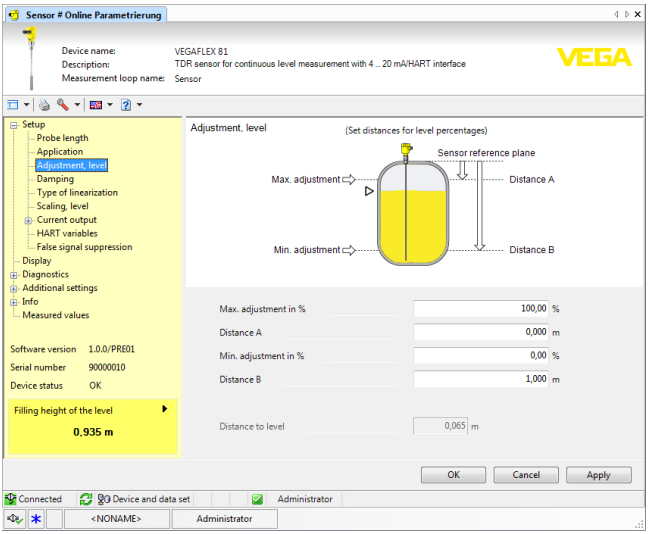


Fig. 15: Example of a DTM view

Standard/Full version

All device DTMs are available as a free-of-charge standard version and as a full version that must be purchased. In the standard version, all functions for complete setup are already included. An assistant for simple project configuration simplifies the adjustment considerably. Saving/printing the project as well as import/export functions are also part of the standard version.

In the full version there is also an extended print function for complete project documentation as well as a save function for measured value and echo curves. In addition, there is a tank calculation program as well as a multiviewer for display and analysis of the saved measured value and echo curves.

The standard version is available as a download under www.vega.com/downloads and "*Software*". The full version is available on CD from the agency serving you.

7.3 Set up with the quick setup

General information

The quick setup is another option for parameter adjustment of the sensor. It allows fast, convenient adjustment of the most important parameters to adapt the sensor quickly to standard applications. To use it, select the function "*Quick setup*" in the start screen.

Start quick setup

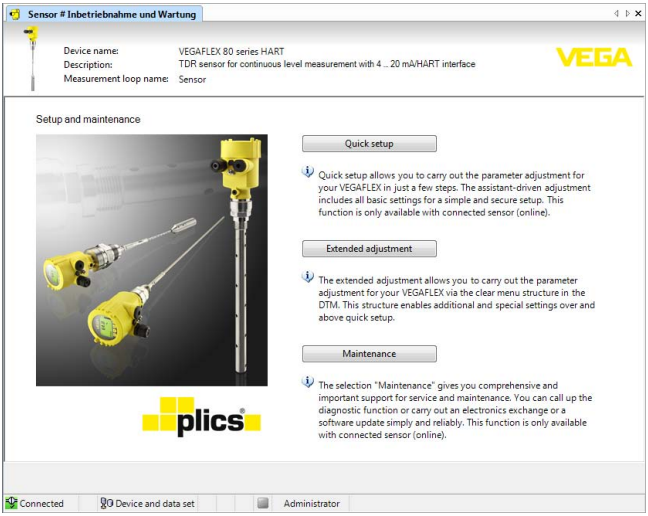

Sensor # Inbetriebnahme und Wartung
Device name: VEGAFLEX 80 series HART
Description: TDR sensor for continuous level measurement with 4 ... 20 mA/HART interface
Measurement loop name: Sensor
VEGA
Setup and maintenance
Quick setup
Quick setup allows you to carry out the parameter adjustment for your VEGAFLEX in just a few steps. The assistant-driven adjustment includes all basic settings for a simple and secure setup. This function is only available with connected sensor (online).
Extended adjustment
The extended adjustment allows you to carry out the parameter adjustment for your VEGAFLEX via the clear menu structure in the DTM. This structure enables additional and special settings over and above quick setup.
Maintenance
The selection "Maintenance" gives you comprehensive and important support for service and maintenance. You can call up the diagnostic function or carry out an electronics exchange or a software update simply and reliably. This function is only available with connected sensor (online).
plics
Connected
Device and data set
Administrator

Fig. 16: Select quick setup

1 *Quick setup*
2 *Extended adjustment*
3 *Maintenance*

Quick setup
With quick setup you can carry out the parameter adjustment of VEGAFLEX 81 for your application in just a few simple steps. The assistant-driven adjustment includes the basic settings for simple, reliable setup and commissioning.

Information:
If the function is inactive, then possibly no instrument is connected. Check the connection to the instrument.

Extended adjustment
With the extended adjustment, you carry out the parameter adjustment for the instrument via the clear menu structure in the DTM (Device Type Manager). This enables additional and special settings over and above those offered by quick setup.

Maintenance
Under the menu item "*Maintenance*" you get comprehensive and important support for servicing and maintenance. You can call up diagnostic functions and carry out an electronics exchange or a software update.

Step 1 of 7
Instrument configuration

Device name
Here, you can find the instrument name. You cannot change this line because the instrument name is unmodifiably saved in the instrument.

Serial number
Here, you can find the serial number of your instrument. You cannot change this line because the serial number is unmodifiably saved in the instrument.

Measurement loop name
Here you can enter a suitable measurement loop name for your VEGAFLEX 81. You can enter a name with max. 19 characters. You can use capital and small letters as well as numbers. The following special characters are also possible: + - . : , ( ) / < >

Probe length modified?
If you have modified the probe length, this must be entered in the selection field.

- If you select "*No*", then the instrument uses automatically the preset length of the default setting.
- If you select "*Yes*", then you can enter in another field the modified length of the instrument.

Probe length L from seal surface
If you have modified the length of the probe, you can enter in this field the modified probe length. Keep the selected unit in mind.

Determine probe length automatically
If you do not know the probe length, you can have the length of the probe determined automatically. The requirement for this is a probe unrestricted and not covered by the medium.

Click to "*Carry out now*", to start the automatic length determination.

Step 2 of 7
Application

Product type
Here you can see which medium type your instrument is suitable for. If this function is inactive, the medium type your instrument is suitable for was already preset.

Information:
In special cases you can change the medium type. This setting can be changed under "*Extended adjustment*".

Application
In this field you can select the application you want to use your instrument for. You have the following selection options:

- Level in the vessel
- Level in the bypass/standpipe
- Interface in the vessel
- Interface in the bypass/standpipe
- Demonstration mode

Level measurement: If you select "*Level*", you can select the properties of the medium in another field.

Interface measurement: If you select "*Interface*", the instrument needs more information, such as the distance to the interface, the dielectric constant of the upper medium or whether or not there is a superimposed gas phase.

Demonstration mode: This mode is suitable for test and demonstration purposes. In this mode, the sensor ignores all logic parameters and reacts immediately to all measured value changes within the measuring range.

Application - Level measurement
The level measurement refers to the product surface which is the limit to the gas phase.

- Liquids
  - Solvents, oils, LPG - dielectric constant ≤ 3
  - Chemical mixtures - dielectric constant > 3 … < 10
  - Water-based - dielectric constant ≥ 10
- Bulk solids
  - Dusts, wood chips - dielectric constant ≤ 1.5
  - Granules, dusts, powder - dielectric constant > 1.5 … < 3
  - Cereals, flour - dielectric constant ≥ 3

Application - Interface measurement
The interface measurement refers to the phase limit between two liquids. The total level is also available as a measured value.

- Superimposed gas phase present
  - Check if there is a superimposed gas phase in the vessel. This is always the case if the total level is never at the process fitting.
- Properties
  - Here you can enter the dielectric constant of the upper medium
  - As an alternative you can enter the distance to the interface

Step 3 of 7
Adjustment

Adjustment for the level measurement
If you have selected level measurement in the previous menu, then you can enter the values for the min. and max. adjustment. The value to be entered refers to the distance from the sealing surface of the process fitting (sensor reference plane) to the surface of the product.

Adjustment for the level and interface measurement
If you have selected interface measurement in the previous menu, then you can enter the values for the min. and max. adjustment of level and interface or accept the values of the level measurement. The entered value refers to the distance from the sealing surface of the process fitting (sensor reference plane) to the total level or interface.

Step 4 of 7
Linearisation

Linearization is required if the measured value should be outputted in proportion to the volume and not the level. The linearization acts identically on the level and the interface measurement. You can find further linearization types in the extended adjustment.

If you have a non-linear vessel, you can select here the respective linearization curve.

- Linear
- Spherical tank
- Horizontal cylindrical tank
- User programmable
- Venturi, trapezoidal weir, rectangular weir

- Palmer-Bowlus-Flume
- V-Notch, rectangular weir

You must enter the following vessel dimensions with non-linear conditions:

- Height of the socket h
- Vessel height D

Step 5 of 7
Setting - Output signal

In this window you can adjust the output signal. When the function is inactive, you can change the settings via the "*Extended adjustment*".

Step 6 of 7
Sensor optimization

These settings allow you to optimize the sensor. With them you can compare a sounded distance with the indicated value and correct it, if necessary.

Probe immersed in the liquid (covered)
Select whether or not the probe is immersed in the medium.

Measured distance to the medium
If the probe is immersed in the medium, you can enter here the measured distance to the medium.

Displayed distance correct?
Is the displayed distance value correct? If you have the possibility, you can enter here the sounded distance to the medium.

False signal suppression
With this function you can carry out the automatic false signal suppression. We recommend carrying out false signal suppression in any case.

Step 7 of 7
Additional settings

When the setup of the instrument is finished, additional settings can be made. These are various backups and the locking of the instrument against unauthorised or inadvertent adjustment.

Prepare a backup file of the instrument parameter adjustment?
For backup purposes, the current parameter adjustment of the instrument is stored in a file. You can use this file later on to restore the instrument parameter adjustment. The complete data set is downloaded from the device. This procedure can last several minutes.

Create instrument documentation?
This function is used to print or create a PDF file of the current parameter adjustment. To read the PDF file, you need a suitable program (for example Acrobat Reader). To print or create the PDF file, all data are downloaded from the device. For this function, the full version of the DTM Collection is required. This procedure can last several minutes.

Store echo curve of the setup in the sensor?
Did you terminate the first setup of the instrument? In such case, we recommend storing the current signal conditions in the device for later instrument tests and diagnostics.

Lock adjustment with PIN after setting?
The instrument is locked with the current PIN. A parameter adjustment is possible only after the PIN is entered again.

7.4 Saving the parameter adjustment data

We recommend documenting or saving the parameter adjustment data via PACTware. That way the data are available for multiple use or service purposes.

8 Set up with other systems

8.1 DD adjustment programs

Device descriptions as Enhanced Device Description (EDD) are available for DD adjustment programs such as, for example, AMS™ and PDM.

The files can be downloaded at www.vega.com/downloads under "*Software*".

8.2 Communicator 375, 475

Device descriptions for the instrument are available as DD or EDD for parameter adjustment with the Field Communicator 375 or 475.

The files can be downloaded at www.vega.com/downloads under "*Software*".

9 Diagnostics and service

9.1 Maintenance

If the device is used correctly, no maintenance is required in normal operation.

9.2 Diagnosis memory

The instrument has several memories which are available for diagnosis purposes. The data remain even with voltage interruption.

Measured value memory

Up to 100,000 measured values can be stored in the sensor in a ring memory. Each entry contains date/time as well as the respective measured value. Storable values are for example:

- Distance
- Filling height
- Percentage value
- Lin. percent
- Scaled
- Current value
- Meas. reliability
- Electronics temperature

When the instrument is shipped, the measured value memory is active and stores distance, measurement certainty and electronics temperature every 3 minutes.

In the "Extended operation", you can select the respective measured values.

The requested values and recording conditions are set via a PC with PACTware/DTM or the control system with EDD. Data are thus read out and also reset.

Event memory

Up to 500 events are automatically stored with a time stamp in the sensor (non-deletable). Each entry contains date/time, event type, event description and value. Event types are for example:

- Modification of a parameter
- Switching on and off times
- Status messages (according to NE 107)
- Error messages (according to NE 107)

The data are read out via a PC with PACTware/DTM or the control system with EDD.

Echo curve memory

The echo curves are stored with date and time and the corresponding echo data. The memory is divided into two sections:

Echo curve of the setup: This is used as reference echo curve for the measurement conditions during setup. Changes in the measurement conditions during operation or buildup on the sensor can thus be recognized. The echo curve of the setup is stored via:

- PC with PACTware/DTM
- Control system with EDD

42283-EN-121112

- Indicating and adjustment module

Further echo curves: Up to 10 echo curves can be stored in a ring buffer in this memory section. Further echo curves are stored via:

- PC with PACTware/DTM
- Control system with EDD

9.3 Status messages

The instrument features self-monitoring and diagnostics according to NE 107 and VDI/VDE 2650. In addition to the status messages in the following tables there are more detailed error messages available under the menu item "*Diagnostics*" via the indicating and adjustment module, PACTware/DTM and EDD.

Status messages

The status messages are classified in the following categories:

- Failure
- Function check
- Out of specification
- Maintenance requirement

and explained by pictographs:

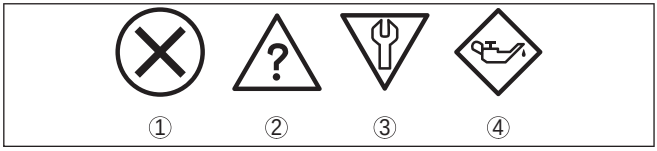


Fig. 17: Pictograms of the status messages

1 Failure - red
2 Function check - orange
3 Out of specification - yellow
4 Maintenance - blue

Failure: Due to a malfunction in the instrument, a failure message is outputted.

This status message is always active. It cannot be deactivated by the user.

Function check: The instrument is in operation, the measured value is temporarily invalid (for example during simulation).

This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.

Out of specification: The measured value is unstable because the instrument specification is exceeded (e.g. electronics temperature).

This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.

Maintenance: Due to external influences, the instrument function is limited. The measurement is affected, but the measured value is still valid. Plan in maintenance for the instrument because a failure is expected in the near future (e.g. due to buildup).

This status message is inactive by default. It can be activated by the user via PACTware/DTM or EDD.

Failure

The following table shows the error codes in the status message "*Failure*" and gives information on the reason and rectification. Keep in mind that some information is only valid with four-wire instruments.

Code Text message	Cause	Rectification
F013 no measured value available	– Sensor does not detect an echo during operation – Process component or probe contaminated or defective	– Check or correct installation and/or parameter adjustment – Clean or exchange process component or probe
F017 Adjustment span too small	– Adjustment not within specification	– Change adjustment according to the limit values (difference between min. and max. ≥ 10 mm)
F025 Error in the linearization table	– Index markers are not continuously rising, for examle unlogical value pairs	– Check values of the linearization table – Delete/create a new linearization table
F036 No operable software	– Failed or interrupted software update	– Repeat software update – Check electronics version – Exchanging the electronics – Send instrument for repair
F040 Error in the electronics	– Hardware defect	– Exchanging the electronics – Send instrument for repair
F041 Probe loss	– Cable probe broken or rod probe defective	– Check probe and exchange, if necessary
F080 General software error	– General software error	– Separate operating voltage briefly
F105 Measured value is determined	– The instrument is still in the start phase, the measured value could not yet be determined	– Wait for the warm-up phase – Duration depending on the version and parameter adjustment max. 5 min.
F113 Communication error	– EMC interferences – Transmission error with the external communication with 4-wire power supply unit	– Remove EMC influences – Exchange 4-wire power supply unit or electronics
F125 Unpermissible electronics temperature	– Temperature of the electronics in the non-specified section	– Check ambient temperature – Isolate electronics – Use instrument with higher temperature range

Code Text message	Cause	Rectification
F260 Error in the calibration	– Error in the calibration carried out in the factory – Error in the EEPROM	– Exchanging the electronics – Send instrument for repair
F261 Error in the instrument settings	– Error during setup – Error when carrying out a reset – False signal suppression faulty	– Carry out a reset – Repeat setup
F264 Installation/ Setup error	– Error during setup	– Check or correct installation and/or parameter adjustment – Check probe length
F265 Measurement function disturbed	– Sensor no longer carries out a measurement	– Carry out a reset – Separate operating voltage briefly
F266 Incorrect supply voltage	– Terminal voltage below specified range	– Check electrical connection – if necessary, increase operating voltage

Function check

The following table shows the error codes and text messages in the status message "*Function check*" and provides information on causes as well as corrective measures.

Code Text message	Cause	Rectification
C700 Simulation active	– A simulation is active	– Finish simulation – Wait for the automatic end after 60 mins.

Out of specification

The following table shows the error codes and text messages in the status message "*Out of specification*" and provides information on causes as well as corrective measures.

Code Text message	Cause	Rectification
S600 Unpermissible electronics temperature	– Temperature of the processing electronics in the non-specified section	– Check ambient temperature – Isolate electronics – Use instrument with higher temperature range

Code Text message	Cause	Rectification
S601 Overfilling	– Level echo in the close range not available	– Reduce level – 100 % adjustment: Increase value – Check mounting socket – Remove possible interfering signals in the close range – Use coaxial probe
S602 Level within the search range, compensation echo	– Compensation echo superimposed by medium	– 100 % adjustment: Increase value
S603 Incorrect supply voltage	– Terminal voltage below specified range	– Check electrical connection – if necessary, increase operating voltage

Maintenance

The following table shows the error codes and text messages in the status message "*Maintenance*" and provides information on causes as well as corrective measures.

Code Text message	Cause	Rectification
M500 Error in the delivery status	– With the reset to delivery status, the data could not be restored	– Repeat reset – Load XML file with sensor data into the sensor
M501 Error in the non-active linearization table	– Hardware error EEPROM	– Exchanging the electronics – Send instrument for repair
M502 Error in the event memory	– Hardware error EEPROM	– Exchanging the electronics – Send instrument for repair
M503 Reliability too low	– Measurement certainty is too low for a reliable measurement – Process component or probe contaminated or defective	– Check installation and process conditions – Clean or exchange process component or probe
M504 Error on an device interface	– Hardware defect	– Exchanging the electronics – Send instrument for repair

Code Text message	Cause	Rectification
M505 no measured value available	– Sensor does not detect an echo during operation	– Check and correct installation and/or parameter adjustment
	– Process component or probe contaminated or defective	– Clean or exchange process component or probe
M506 Installation/ Setup error	– Error during setup	– Check and correct installation and/or parameter adjustment – Check probe length
M507 Error in the instrument settings	– Error during setup – Error when carrying out a reset – False signal suppression faulty	– Carry out reset and repeat setup

9.4 Rectify faults

Reaction when malfunctions occur

The operator of the system is responsible for taking suitable measures to rectify faults.

Procedure for fault rectification

The first measures are:

- Evaluation of fault messages, for example via the indicating and adjustment module
- Checking the output signal with 4 … 20 mA instruments
- Treatment of measurement errors

Further comprehensive diagnostics options offer a PC with the software PACTware and the suitable DTM. In many cases, the reasons can be determined in this way and faults can be rectified.

Check the 4 … 20 mA signal

Connect a handmultimeter in the suitable measuring range according to the wiring plan. The following table describes possible errors in the current signal and helps to remove them:

Error	Cause	Rectification
4 … 20 mA signal not stable	– Level fluctuations	– Set damping according to the instrument via the indicating and adjustment module or PACTware/ DTM

Error	Cause	Rectification
4 … 20 mA signal missing	– Electrical connection faulty	– Check connection according to chapter "Connection steps" and if necessary, correct according to chapter "Wiring plan".
	– Voltage supply missing	– Check cables for breaks; repair if necessary
	– Operating voltage too low or load resistance too high	– Check, adapt if necessary
Current signal greater than 22 mA or less than 3.6 mA	– Electronics module in the sensor defective	– Exchange the instrument or send it in for repair

Treatment of measurement errors

The below tables show typical examples for application-relevant measurement errors. There are two measurement errors:

- Constant level
- Filling
- Emptying

The images in column "*Error pattern*" show the real level with a broken line and the level displayed by the sensor as a continuous line.

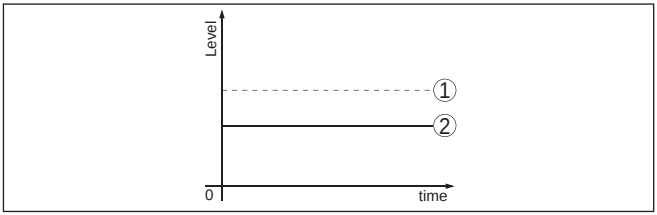
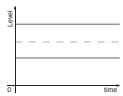


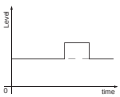
Fig. 18: The broken line 1 shows the real level, the continuous line 2 shows the level displayed by the sensor

Note:

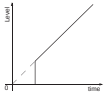
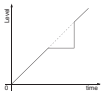
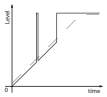
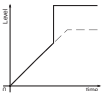
- Wherever the sensor displays a constant value, the reason could also be the fault setting of the current output to "*Hold value*"
- In case of a too low level indication, the reason could be a line resistance that is too high

Measurement error with constant level

Fault description	Error pattern	Cause	Rectification
1. Measured value shows a too low or too high level		– Min./max. adjustment not correct	– Adapt min./max. adjustment
		– Wrong linearization curve	– Adapt linearization curve
		– Running time error (small measurement error close to 100 %/serious error close to 0 %)	– Repeat setup

Fault description	Error pattern	Cause	Rectification
2. Measured value jumps towards 100 %		– Due to the process, the amplitude of the product echo sinks – A false signal suppression was not carried out	– Carry out false signal suppression
		– Amplitude or position of a false signal has changed (e.g. buildup); false signal suppression no longer matches	– Determine the reason for the changed false signals, carry out false signal suppression, e.g. with buildup

Measurement error during filling

Fault description	Error pattern	Cause	Rectification
3. Measured value remains in the area of the bottom during filling		– Echo from the probe end larger than the product echo, for example, with products with ε_r < 2.5 oil-based, solvents, etc.	– Check application parameter "Medium" and "Vessel height", adapt if necessary
4. Measured value remains momentarily unchanged during filling and then jumps to the correct level		– Turbulence on the product surface, quick filling	– Check application parameters, change if necessary, e.g. in dosing vessel, reactor
5. measured value jumps sporadically to 100 % during filling		– Varying condensation or contamination on the probe end	– Carry out false signal suppression
6. Measured value jumps to ≥ 100 % or 0 m distance		– Level echo is no longer detected in the close range due to false signals in the close range. The sensor goes into overfill protection mode. The max. level (0 m distance) as well as the status message "Overfill protection" are outputted.	– Remove false signals in the close range – Check installation conditions – If possible, switch off the function "Overfill protection"

Measurement error during emptying

Fault description	Error pattern	Cause	Rectification
7. Measured value remains unchanged in the close range during emptying		– False signal larger than the level echo – Level echo too small	– Remove false signals in the close range – Remove contamination on the probe. After having removed the source of the false signals, the false signal suppression must be deleted. – Carry out a new false signal suppression
8. Measured value remains reproducible in one position during emptying		– Stored false signals in this position are larger than the level echo	– Delete false signal memory – Carry out a new false signal suppression

Reaction after fault rectification

Depending on the reason for the fault and the measures taken, the steps described in chapter "*Setup*" must be carried out again or must be checked for plausibility and completeness.

24 hour service hotline

Should these measures not be successful, please call in urgent cases the VEGA service hotline under the phone no. **+49 1805 858550**.

The hotline is also available outside the normal working hours on seven days a week around the clock.

Since we offer this service worldwide, the support is in the English language. The service itself is free of charge, the only costs involved are the normal call charges.

9.5 Exchanging the electronics module

If the electronics module is defective, it can be replaced by the user.

In Ex applications only one instrument and one electronics module with respective Ex approval may be used.

If there is no electronics module available on site, the electronics module can be ordered through the agency serving you. The electronics modules are adapted to the respective sensor and differ in signal output or voltage supply.

The new electronics module must be loaded with the default settings of the sensor. These are the options:

- In the factory
- Or on site by the user

In both cases, the serial number of the sensor is needed. The serial numbers are stated on the type label of the instrument, on the inside of the housing as well as on the delivery note.

When loading on site, first of all the order data must be downloaded from the Internet (see operating instructions manual "*Electronics module*").

9.6 Software update

The following components are required to update the sensor software:

- Sensor
- Voltage supply
- Interface adapter VEGACONNECT 4
- PC with PACTware
- Current sensor software as file

You can find the actual sensor software as well as detailed information of the procedure under "www.vega.com/downloads" and "*Software*".

Caution:
Instruments with approvals can be bound to certain software versions. Therefore make sure that the approval remains effective with a software update.

You can find detailed information on www.vega.com/downloads and "*Approvals*".

9.7 How to proceed in case of repair

You can find a repair form as well as detailed information on how to proceed under www.vega.com/downloads and "*Forms and certificates*".

By doing this you help us carry out the repair quickly and without having to call back for needed information.

If a repair is necessary, please proceed as follows:

- Print and fill out one form per instrument
- Clean the instrument and pack it damage-proof
- Attach the completed form and, if need be, also a safety data sheet outside on the packaging
- Please contact for the return shipment the agency serving you. You can find the agency on our home page www.vega.com.

10 Dismounting

10.1 Dismounting steps

Warning:
Before dismounting, be aware of dangerous process conditions such as e.g. pressure in the vessel, high temperatures, corrosive or toxic products etc.

Take note of chapters "*Mounting*" and "*Connecting to power supply*" and carry out the listed steps in reverse order.

10.2 Disposal

The instrument consists of materials which can be recycled by specialised recycling companies. We use recyclable materials and have designed the electronics to be easily separable.

Correct disposal avoids negative effects on humans and the environment and ensures recycling of useful raw materials.

Materials: see chapter "*Technical data*"

If you have no way to dispose of the old instrument properly, please contact us concerning return and disposal.

WEEE directive 2002/96/EG
This instrument is not subject to the WEEE directive 2002/96/EG and the respective national laws. Pass the instrument directly on to a specialised recycling company and do not use the municipal collecting points. These may be used only for privately used products according to the WEEE directive.

11 Supplement

11.1 Technical data

General data

316L corresponds to 1.4404 or 1.4435	
Materials, wetted parts	
– Process fitting	316L and Aluminium oxide-ceramic 99.7 % (Al_2O_3), Hastelloy C22 (2.4602) and Aluminium oxide-ceramic 99.7 % (Al_2O_3)
– Process fitting - sealed elastomer-free	316L and borosilicate glass GPC 540[1)]
– Process seal on the instrument side (rod leadthrough)	FKM (SHS FPM 70C3 GLT), FFKM (Kalrez 6375), EPDM (A+P 75.5/KW75F)
– Process seal	On site (instruments with thread: Klingersil C-4400 is attached)
– Inner conductor (up to the separation rod)	316L
– Tube: ø 21.3 mm (0.839 in)	316L or Hastelloy C22 (2.4602)
– Tube: ø 42.2 mm (1.661 in)	316L or Hastelloy C22 (2.4602)
Materials, non-wetted parts	
– Plastic housing	plastic PBT (Polyester)
– Aluminium die-casting housing	Aluminium die-casting AlSi10Mg, powder-coated - basis: Polyester
– Stainless steel housing - precision casting	316L
– Stainless steel housing, electropolished	316L
– Seal between housing and housing cover	NBR (stainless steel housing, precision casting), silicone (aluminium/plastic housing; stainless steel housng, electropolished)
– Inspection window in housing cover (optional)	Polycarbonate (with Ex d version: glass)
– Ground terminal	316L
Ohmic contact	Between ground terminal, process fitting and probe
Process fittings - tube: ø 21.3 mm (0.839 in)	
– Pipe thread, cylindrical (ISO 228 T1)	G¾, G1, G1½ according to DIN 3852-A
– American pipe thread, conical (ASME B1.20.1)	¾ NPT, 1 NPT, 1½ NPT
– Flanges	e.g. DIN from DN 25, ANSI from 1"
Process fittings - tube: ø 42.2 mm (1.661 in)	
– Pipe thread, cylindrical (ISO 228 T1)	G1½ according to DIN 3852-A
– American pipe thread, conical (ASME B1.20.1)	1½ NPT
– Flanges	DIN from DN 50, ANSI from 2"

1) Not suitable for steam applications

Weight	
– Instrument weight (depending on process fitting)	approx. 0.8 … 8 kg (0.176 … 17.64 lbs)
– Tube: ø 21.3 mm (0.839 in)	approx. 1110 g/m (11.9 oz/ft)
– Tube: ø 42.2 mm (1.661 in)	approx. 3100 g/m (33.3 oz/ft)
Probe length L (from seal surface)	
– Tube: ø 21.3 mm (0.839 in)	up to 6 m (19.69 ft)
– Tube: ø 42.2 mm (1.661 in)	up to 6 m (19.69 ft)
– Trimming accuracy - tube	< 1 mm (0.039 in)
Lateral load	
– Tube: ø 21.3 mm (0.839 in)	60 Nm (44 lbf ft)
– Tube: ø 42.2 mm (1.661 in)	300 Nm (221 lbf ft)
Torque for NPT cable glands and Conduit tubes	
– Plastic housing	max. 10 Nm (7.376 lbf ft)
– Aluminium/Stainless steel housing	max. 50 Nm (36.88 lbf ft)

Input variable

Measured variable	Level of liquids
Min. dielectric figure of the medium	$\varepsilon_r \geq 1.4$

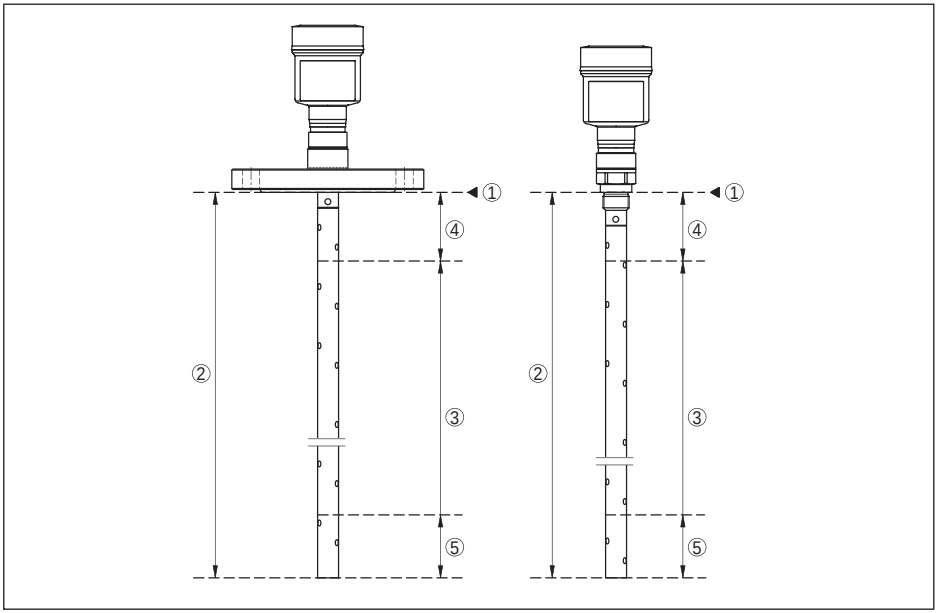


Fig. 27: Measuring ranges - VEGAFLEX 81

1 Reference plane
2 Probe length L
3 Measuring range (default setting refers to the measuring range in water)
4 Upper dead band (see diagrams under Accuracy - grey section)
5 Lower dead band (see diagrams under Accuracy - grey section)

Output variable

Output

– Physical layer	Digital output signal according to standard EIA-485
– Bus specifications	Modbus Application Protocol V1.1b, Modbus over serial line V1.02
– Protocols	Modbus RTU, Modbus ASCII, Levelmaster
Max. transmission rate	9.6 Kbit/s

Accuracy (according to DIN EN 60770-1)

Process reference conditions according to DIN EN 61298-1

– Temperature	+18 … +30 °C (+64 … +86 °F)
– Relative humidity	45 … 75 %
– Air pressure	+860 … +1060 mbar/+86 … +106 kPa (+12.5 … +15.4 psig)

Installation reference conditions

– Min. distance to installations	> 500 mm (19.69 in)
– Vessel	metallic, ø 1 m (3.281 ft), centric installation, process fitting flush with the vessel ceiling
– Medium	Water/Oil (dielectric constant ~2.0)

– Installation	Probe end does not touch the vessel bottom
Sensor parameter adjustment	Gating out of false signals carried out
Deviation[2)3)]	See following diagrams

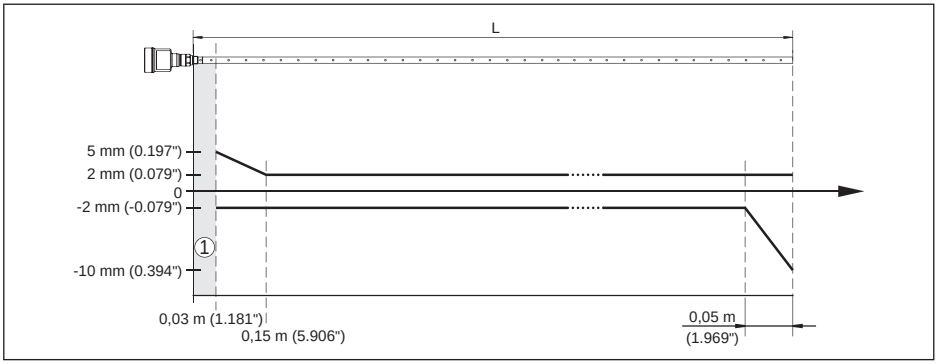


Fig. 28: Deviation VEGAFLEX 81 in coax version in water

1 Dead band - no measurement possible in this area
L Probe length

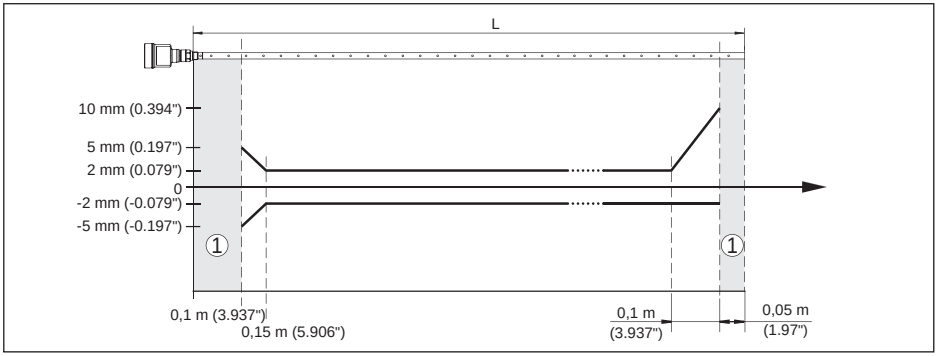


Fig. 29: Deviation VEGAFLEX 81 in coax version in oil

1 Dead band - no measurement possible in this area
L Probe length

Reproducibility	≤ ±1 mm

Variables influencing measurement accuracy

Temperature drift - Digital output	±3 mm/10 K relating to the max. measuring range or max. 10 mm (0.394 in)

[2)] Depending on the installation conditions, there can be deviations which can be rectified with an adaptation of the adjustment or a change of the measured value offset in the DTM service mode
[3)] The dead bands can be optimizes by a false signal suppression.

Additional deviation through strong, high frequency electromagnetic fields acc. to EN 61326	< ±10 mm (< ±0.394 in)

Characteristics and performance data

Measuring cycle time	500 ms
Step response time[4]	≤ 3 s
Tracking speed of the measuring window max.	1 m/min

Ambient conditions

Ambient, storage and transport temperature	-40 … +80 °C (-40 … +176 °F)

Process conditions

For the process conditions, please also note the specifications on the type label. The lowest value always applies.

The measurement error from the process conditions is in the specified pressure and temperature range of below 1 %.

Process pressure	-1 … +40 bar/-100 … +4000 kPa (-14.5 … +580 psig), depending on the process fitting
Vessel pressure relating to the flange nominal stage	see supplementary instructions manual "*Flanges according to DIN-EN-ASME-JIS*"

Process temperature (thread or flange temperature)

– FKM (SHS FPM 70C3 GLT)	-40 … +150 °C (-40 … +302 °F)
– EPDM (A+P 75.5/KW75F)	-40 … +150 °C (-40 … +302 °F)
– FFKM (Kalrez 6375)	-20 … +150 °C (-4 … +302 °F)
– FFKM (Kalrez 6375)	-20 … +200 °C (-4 … +392 °F)

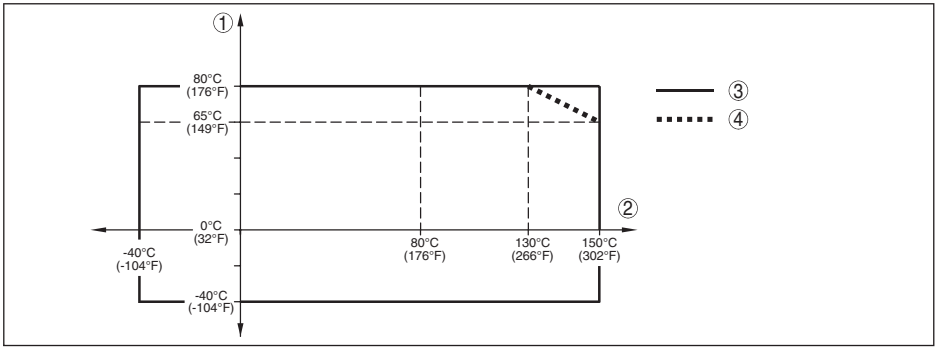


Fig. 30: Ambient temperature - process temperature, standard version

1 Ambient temperature
2 Process temperature (depending on the seal material)
3 Maximum permissible temperature - standard
4 Limited temperature range - plastic housing and stainless steel housing, electropolished

[4] Time span after a sudden measuring distance change by max. 0.5 m in liquid applications, max 2 m with bulk solids applications, until the output signal has taken for the first time 90 % of the final value (IEC 61298-2).

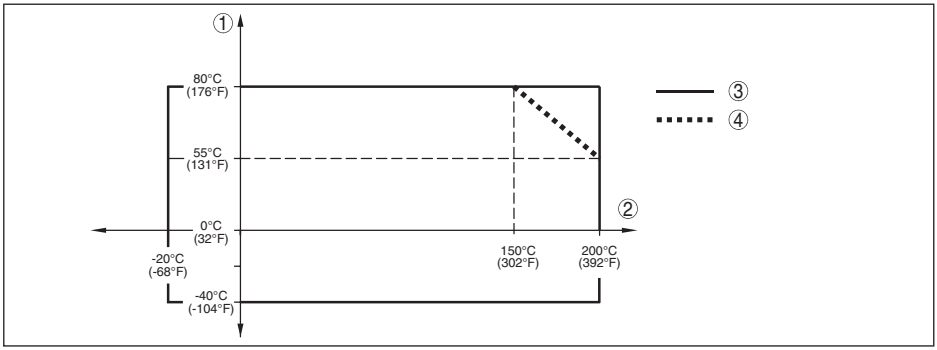


Fig. 31: Ambient temperature - process temperature, version with temperature adapter

1 Ambient temperature
2 Process temperature (depending on the seal material)
3 Maximum permissible temperature - standard
4 Limited temperature range - plastic housing and stainless steel housing, electropolished

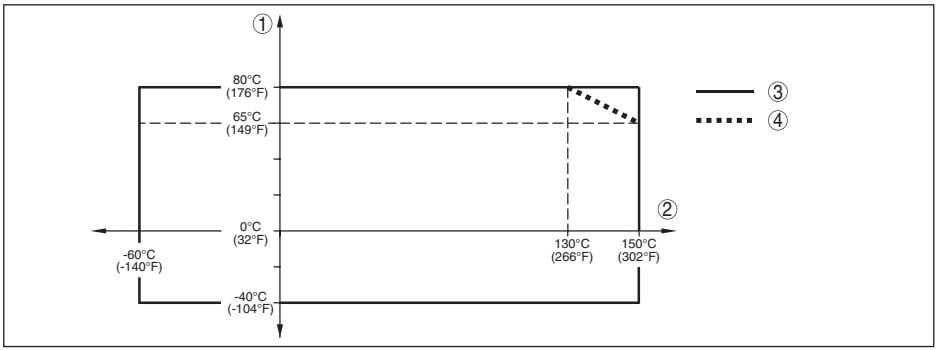


Fig. 32: Ambient temperature - process temperature, elastomer-free version for ammonia applications

1 Ambient temperature
2 Process temperature (depending on the seal material)
3 Maximum permissible temperature - standard
4 Limited temperature range - plastic housing and stainless steel housing, electropolished

Vibration resistance

– Instrument housing	4 g at 5 … 200 Hz according to EN 60068-2-6 (vibration with resonance)
– Coax probe	1 g with 5 … 200 Hz according EN 60068-2-6 (vibration at resonance) with tube length 50 cm (19.69 in)

Shock resistance

– Instrument housing	100 g, 6 ms according to EN 60068-2-27 (mechanical shock)
– Coax probe	25 g, 6 ms according to EN 60068-2-27 (mechanical shock) with tube length 50 cm (19.69 in)

Electromechanical data - version IP 66/IP 67

Options of the cable entry

– Cable gland	M20 x 1.5 (cable: ø 5 … 9 mm)
– Cable entry	½ NPT
– Blind plug	M20 x 1.5; ½ NPT
– Closing cap	M20 x 1.5; ½ NPT
Plug options	
– Supply and signal circuit (only with low voltage)	M12 x 1
– Indication circuit	M12 x 1
Wire cross-section (spring-loaded terminals)	
– Massive wire, cord	0.2 … 2.5 mm² (AWG 24 … 14)
– Stranded wire with end sleeve	0.2 … 1.5 mm² (AWG 24 … 16)

Indicating and adjustment module	
Voltage supply and data transmission	through the sensor
Indication	LC display in dot matrix
Measured value indication	
– Number of digits	5
– Size of digits	W x H = 7 x 13 mm
Adjustment elements	4 keys
Protection rating	
– unassembled	IP 20
– mounted into the sensor without cover	IP 40
Materials	
– Housing	ABS
– Inspection window	Polyester foil

Integrated clock	
Date format	Day.Month.Year
Time format	12 h/24 h
Time zone Ex factory	CET

Measurement electronics temerature	
Resolution	1 °C (1.8 °F)
Accuracy	±1 °C (1.8 °F)

Voltage supply	
Operating voltage	8 … 30 V DC
Interpolation protection	Available

Electrical protective measures	
Protection rating	IP 66/IP 67
Overvoltage category	III
Protection class	I

Approvals

Instruments with approvals can have different technical data depending on the version.

For that reason the associated approval documents of these instruments must be carefully noted. They are part of the delivery or can be downloaded under www.vega.com and "*VEGA Tools*" as well as under "Downloads" and "*Approvals*".

11.2 Basics Modbus

Bus description

The Modbus protocol is a communication protocol for the communication between instruments. It is based on a Master/Slave or Client/Server architecture. By means of Modbus, a Master and several Slaves can be connected. Each bus participant has an unambiguous address and can send messages to the bus. This is initiated by the Master, the addessed Slave answers. The versions Ethernet and serial (EIA-232 and EIA-485) as well as the modes ASCII, TCP and RTU are available for the data transfer. In the RTU and ASCII mode interesting here, data will be transmitted in binary form. The telegram consists generally of the address, the function, the data as well as the transmission check.

Bus architecture

In the version Modbus RTU, up to 32 participants can be connected to the bus. The length of the twisted two-wire cable can be up to 1200 m. The bus must be terminated on both sides at the last bus participant with a terminating resistor of 120 Ohm. The resistor is already integrated in the VEGAFLEX 81 and is activated/deactivated via a slide switch.

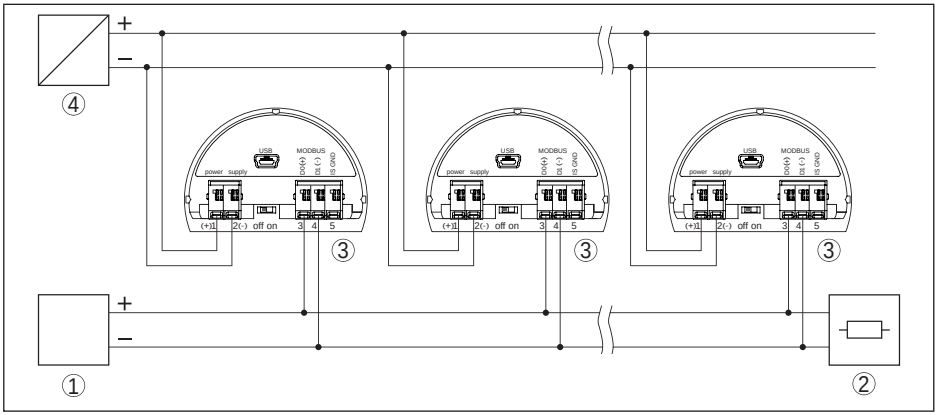


Fig. 33: Bus architecture Modbus

1 RTU
2 Connection resistor
3 Bus participant
4 Voltage supply

Protocol description

The VEGAFLEX 81 is suitable for connection to the following RTUs with Modbus RTU or ASCII protocol.

RTU	Protocol
ABB Totalflow	Modbus RTU, ASCII
Bristol ControlWaveMicro	Modbus RTU, ASCII
Fisher ROC	Modbus RTU, ASCII
ScadaPack	Modbus RTU, ASCII
Thermo Electron Autopilot	Modbus RTU, ASCII

Parameters for the bus communication

The VEGAFLEX 81 is preset with the default values:

Parameter	Configurable Values	Default Value
Baud Rate	1200, 2400, 4800, 9600, 19200	9600
Start Bits	1	1
Data Bits	7, 8	8
Parity	None, Odd, Even	None
Stop Bits	1, 2	1
Address range Modbus	1 … 255	246

Start bits and data bits cannot be modified.

General configuration of the host

The data exchange with status and variables between field device and host is carried out via register. For this, a configuration in the host is required. Floating point numbers with short prevision (4 bytes) according to IEEE 754 are transmitted with individually selectable order of the data bytes (byte transmission order). This "*Byte transmission order*" is determined in the parameter "*Format Code*". Hence the RTU knows the registers of the VEGAFLEX 81 which must be contacted for the variables and status information.

Format Code	Byte transmission order
0	ABCD
1	CDAB
2	DCBA
3	BADC

11.3 Modbus register

Holding Register

The Holding registers consist of 16 bit. They can be read and written. Before each command, the address (1 byte), after each command, a CRC (2 byte) is sent.

Register Name	Register Number	Type	Configurable Values	Default Value	Unit
Address	200	Word	1 … 255	246	-
Baud Rate	201	Word	1200, 2400, 4800, 9600, 19200	9600	-

Register Name	Register Number	Type	Configurable Values	Default Value	Unit
Parity	202	Word	0 = None, 1 = Odd, 2 = Even	0	-
Stopbits	203	Word	1 = None, 2 = Two	1	-
Delay Time	206	Word	10 … 250	50	ms
Byte Oder (Floating point format)	3000	Word	0, 1, 2, 3	0	-

Input register

The input registers consist of 16 bits. They can only be read out. Before each command, the address (1 byte) is sent, after each command a CRC (2 bytes) is sent.

PV, SV, TV and QV can be adjusted via the sensor DTM.

Register Name	Register Number	Type	Note
Status	100	DWord	Bit 0: Invalid Measurement Value PV Bit 1: Invalid Measurement Value SV Bit 2: Invalid Measurement Value TV Bit 3: Invalid Measurement Value QV
PV Unit	104	DWord	Unit Code
PV	106		Primary Variable in Byte Order CDAB
SV Unit	108	DWord	Unit Code
SV	110		Secondary Variable in Byte Order CDAB
TV Unit	112	DWord	Unit Code
TV	114		Third Variable in Byte Order CDAB
QV Unit	116	DWord	Unit Code
QV	118		Quarternary Variable in Byte Order CDAB
Status	1300	DWord	See Register 100
PV	1302		Primary Variable in Byte Order of Register 3000
SV	1304		Secondary Variable in Byte Order of Register 3000
TV	1306		Third Variable in Byte Order of Register 3000
QV	1308		Quarternary Variable in Byte Order of Register 3000
Status	1400	DWord	See Register 100
PV	1402		Primary Variable in Byte Order CDAB
Status	1412	DWord	See Register 100
SV	1414		Secondary Variable in Byte Order CDAB
Status	1424	DWord	See Register 100
TV	1426		Third Variable in Byte Order CDAB
Status	1436	DWord	See Register 100

Register Name	Register Number	Type	Note
QV	1438		Quarternary Variable in Byte Order CDAB
Status	2000	DWord	See Register 100
PV	2002	DWord	Primary Variable in Byte Order ABCD (Big Endian)
SV	2004	DWord	Secondary Variable in Byte Order ABCD (Big Endian)
TV	2006	DWord	Third Variable in Byte Order ABCD (Big Endian)
QV	2008	DWord	Quarternary Variable in Byte Order ABCD (Big Endian)
Status	2100	DWord	See Register 100
PV	2102	DWord	Primary Variable in Byte-Reihenfolge DCBA (Little Endian)
SV	2104	DWord	Secondary Variable in Byte-Reihenfolge DCBA (Little Endian)
TV	2106	DWord	Third Variable in Byte-Reihenfolge ABCD DCBA (Little Endian)
QV	2108	DWord	Quarternary Variable in Byte-Reihenfolge DCBA (Little Endian)
Status	2200	DWord	See Register 100
PV	2202	DWord	Primary Variable in Byte Order BACD (Middle Endian)
SV	2204	DWord	Secondary Variable in Byte Order BACD (Middle Endian)
TV	2206	DWord	Third Variable in Byte Order BACD (Middle Endian)
QV	2208	DWord	Quarternary Variable in Byte Order BACD (Middle Endian)

Unit Codes for Register 104, 108, 112, 116

Unit Code	Measurement Unit
32	Degree Celsius
33	Degree Fahrenheit
40	US Gallon
41	Liters
42	Imperial Gallons
43	Cubic Meters
44	Feet
45	Meters
46	Barrels
47	Inches
48	Centimeters
49	Millimeters

Unit Code	Measurement Unit
111	Cubic Yards
112	Cubic Feet
113	Cubic Inches

11.4 Modbus RTU commands

FC3 Read Holding Register

With this command, any number (1-127) of holding registers can be read out. The start register, from which the readout should start, and the number of registers are transmitted.

Request:

Parameter	Length	Code/Data
Function Code	1 Byte	0x03
Start Address	2 Bytes	0x0000 to 0xFFFF
Number of Registers	2 Bytes	1 to 127 (0x7D)

Response:

Parameter	Length	Code/Data
Function Code	1 Byte	0x03
Start Address	2 Bytes	2*N
Register Value	N*2 Bytes	Data

FC4 Read Input Register

With this command, any number (1-127) of input registers can be read out. The start register, from which the readout should start, and the number of registers are transmitted.

Request:

Parameter	Length	Code/Data
Function Code	1 Byte	0x04
Start Address	2 Bytes	0x0000 to 0xFFFF
Number of Registers	N*2 Bytes	1 to 127 (0x7D)

Response:

Parameter	Length	Code/Data
Function Code	1 Byte	0x04
Start Address	2 Bytes	2*N
Register Value	N*2 Bytes	Data

FC6 Write Single Register

With this function code an individual holding register can be written.

Request:

Parameter	Length	Code/Data
Function Code	1 Byte	0x06
Start Address	2 Bytes	0x0000 to 0xFFFF
Number of Registers	2 Bytes	Data

Response:

Parameter	Length	Code/Data
Function Code	1 Byte	0x04
Start Address	2 Bytes	2*N
Register Value	2 Bytes	Data

FC8 Diagnostics

With this function code different diagnostic functions can be triggered or diagnostic values read out.

Request:

Parameter	Length	Code/Data
Function Code	1 Byte	0x08
Sub Function Code	2 Bytes	
Data	N*2 Bytes	Data

Response:

Parameter	Length	Code/Data
Function Code	1 Byte	0x08
Sub Function Code	2 Bytes	
Data	N*2 Bytes	Data

Implemented function codes:

Sub Function Code	Name
0x00	Return Data Request
0x0B	Return Message Counter

With sub function codes 0x00 only one 16 bit value can be written.

FC16 Write Multiple Register

With this function code, several holding registers can be writen. Only registers can be written in an enquiry which are immediately consecutive. If there are gaps (registers do not exist) between the registers, then they cannot be written in a telegram.

Request:

Parameter	Length	Code/Data
Function Code	1 Byte	0x10
Start Address	2 Bytes	0x0000 to 0xFFFF
Register Value	2 Bytes	0x0001 to 0x007B

Parameter	Length	Code/Data
Byte Number	1 Byte	2*N
Register Value	N*2 Bytes	Data

Response:

Parameter	Length	Code/Data
Function Code	1 Byte	0x10
Sub Function Code	2 Bytes	0x0000 to 0xFFFF
Data	2 Bytes	0x01 to 0x7B

FC17 Report Slave ID

With this function code, the Slave ID can be queried.

Request:

Parameter	Length	Code/Data
Function Code	1 Byte	0x11

Response:

Parameter	Length	Code/Data
Function Code	1 Byte	0x11
Byte Number	1 Byte	
Slave ID	1 Byte	
Run Indicator Status	1 Byte	

FC43 Sub 14, Read Device Identification

With this function code, the Device Identification can be queried.

Request:

Parameter	Length	Code/Data
Function Code	1 Byte	0x2B
MEI Type	1 Byte	0x0E
Read Device ID Code	1 Byte	0x01 to 0x04
Object ID	1 Byte	0x00 to 0xFF

Response:

Parameter	Length	Code/Data
Function Code	1 Byte	0x2B
MEI Type	1 Byte	0x0E
Read Device ID Code	1 Byte	0x01 to 0x04
Confirmity Level	1 Byte	0x01, 0x02, 0x03, 0x81, 0x82, 0x83
More follows	1 Byte	00/FF
Next Object ID	1 Byte	Object ID number
Number of Objects	1 Byte	

Parameter	Length	Code/Data
List of Object ID	1 Byte	
List of Object length	1 Byte	
List of Object value	1 Byte	Depending on the Object ID

11.5 Levelmaster commands

The VEGAFLEX 81 is also suitable for connection to the following RTUs with Levelmaster protocol. The Levelmaster protocol is often called "*Siemens*" "*Tank protocol*".

RTU	Protocol
ABB Totalflow	Levelmaster
Kimray DACC 2000/3000	Levelmaster
Thermo Electron Autopilot	Levelmaster

Parameters for the bus communication

The VEGAFLEX 81 is preset with the default values:

Parameter	Configurable Values	Default Value
Baud Rate	1200, 2400, 4800, 9600, 19200	9600
Start Bits	1	1
Data Bits	7, 8	8
Parity	None, Odd, Even	None
Stop Bits	1, 2	1
Address range Levelmaster	32	32

The Levelmaster commands are based on the following syntax:

- Capital letters are at the beginning of certain data fields
- Small letters stand for data fields
- All commands are terminated with "*<cr>*" (carriage return)
- All commands start with "*Uuu*", whereby "*uu*" stands for the address (00-31)
- "*" can be used as a joker for any position in the address. The sensor always converts this in its address. In case of more than one sensor, the joker must not be used, because otherwise several slaves will answer
- Commands that modify the instrument return the command with "*OK*". "*EE-ERROR*" replaces "*OK*" if there was a problem changing the configuration

Report Level (and Temperature)

Request:

Parameter	Length	Code/Data
Report Level (and Temperature)	4 characters ASCII	Uuu?

Response:

Parameter	Length	Code/Data
Report Level (and Temperature)	24 characters ASCII	UuuDlll.llFtttEeeeeWwwww uu = Address lll.ll = PV in inches ttt = Temperature in Fahrenheit eeee = Error number (0 no error, 1 level data not readable) wwww = Warning number (0 no warning)

Level in inches is repeated for sensors with 2 levels. PV value is transmitted as first measured value, SV as second measured value.

PV, SV, TV and QV can be adjusted via the sensor DTM.

Report Unit Number

Request:

Parameter	Length	Code/Data
Report Unit Number	5 characters ASCII	U**N?

Response:

Parameter	Length	Code/Data
Report Level (and Temperature)	6 characters ASCII	UuuNnn

Assign Unit Number

Request:

Parameter	Length	Code/Data
Assign Unit Number	6 characters ASCII	UuuNnn

Response:

Parameter	Length	Code/Data
Assign Unit Number	6 characters ASCII	UuuNOK uu = new Address

Set number of Floats

Request:

Parameter	Length	Code/Data
Set number of Floats	5 characters ASCII	UuuFn

Response:

Parameter	Length	Code/Data
Set number of Floats	6 characters ASCII	UuuFOK

If the number is set to 0, no level is returned

Set Baud Rate

Request:

Parameter	Length	Code/Data
Set Baud Rate	8 (12) characters ASCII	UuuBbbbb[b][pds] Bbbbb[b] = 1200, 9600 (default) pds = parity, data length, stop bit (optional) parity: none = 81, even = 71 (default), odd = 71

Response:

Parameter	Length	Code/Data
Set Baud Rate	11 characters ASCII	

Example: U01B9600E71

Change instrument on address 1 to baudrate 9600, parity even, 7 data bits, 1 stop bit

Set Receive to Transmit Delay

Request:

Parameter	Length	Code/Data
Set Receive to Transmit Delay	7 characters ASCII	UuuRmmm mmm = milliseconds (50 bis 250), default = 127 ms

Response:

Parameter	Length	Code/Data
Set Receive to Transmit Delay	6 characters ASCII	UuuROK

Report Number of Floats

Request:

Parameter	Length	Code/Data
Set Receive to Transmit Delay	4 characters ASCII	UuuF

Response:

Parameter	Length	Code/Data
Set Receive to Transmit Delay	5 characters ASCII	UuuFn n = number of measurement values (0, 1 or 2)

Report Receive to Transmit Delay

Request:

Parameter	Length	Code/Data
Report Receive to Transmit Delay	4 characters ASCII	UuuR

Response:

Parameter	Length	Code/Data
Report Receive to Transmit Delay	7 characters ASCII	UuuRmmm mmm = milliseconds (50 bis 250), default = 127 ms

Error codes

Error Code	Name
EE-Error	Error While Storing Data in EEPROM
FR-Error	Erorr in Frame (to short, to long, wrong data)
LV-Error	Value out of limits

11.6 Configuration of typical Modbus hosts

Fisher ROC 809

Wiring plan

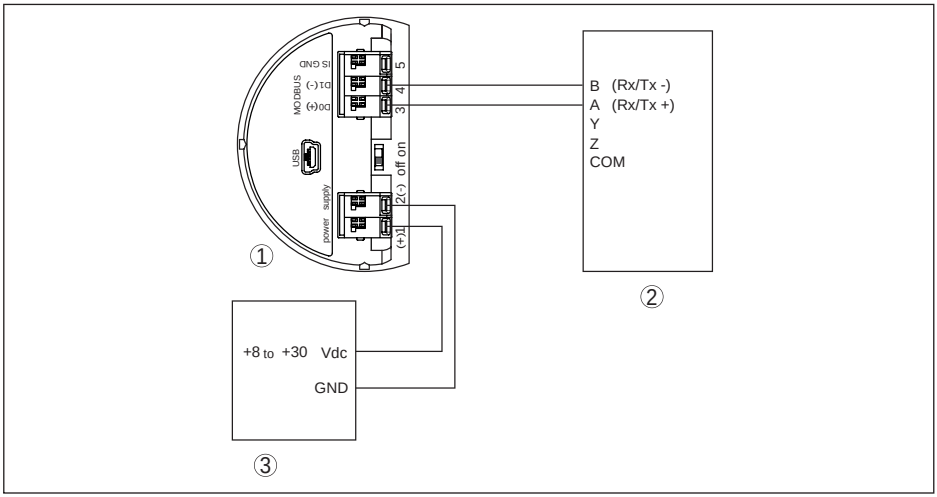


Fig. 34: Connection of VEGAFLEX 81 to RTU Fisher ROC 809

1 VEGAFLEX 81
2 RTU Fisher ROC 809
3 Voltage supply

Parameter

Parameter	Value
Baud Rate	9600
Floating Point Format Code	0
RTU Data Type	Conversion Code 66
Input Register Base Number	0

The basic number of the input registers is always added to the input register address of VEGAFLEX 81.

Address 1300 must hence be entered as register address for RTU Fisher ROC 809.

ABB Total Flow

Wiring plan

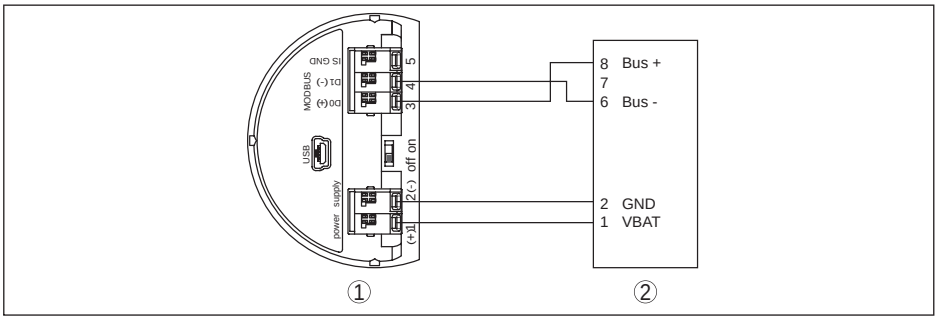


Fig. 35: Connection of VEGAFLEX 81 to RTU ABB Total Flow

1 VEGAFLEX 81
2 RTU ABB Total Flow

Parameter

Parameter	Value
Baud Rate	9600
Floating Point Format Code	0
RTU Data Type	16 Bit Modicon
Input Register Base Number	1

The basic number of the input registers is always added to the input register address of VEGAFLEX 81.

Address 1303 must hence be entered as register address for 1302 for RTU ABB Total Flow.

Thermo Electron Autopilot

Wiring plan

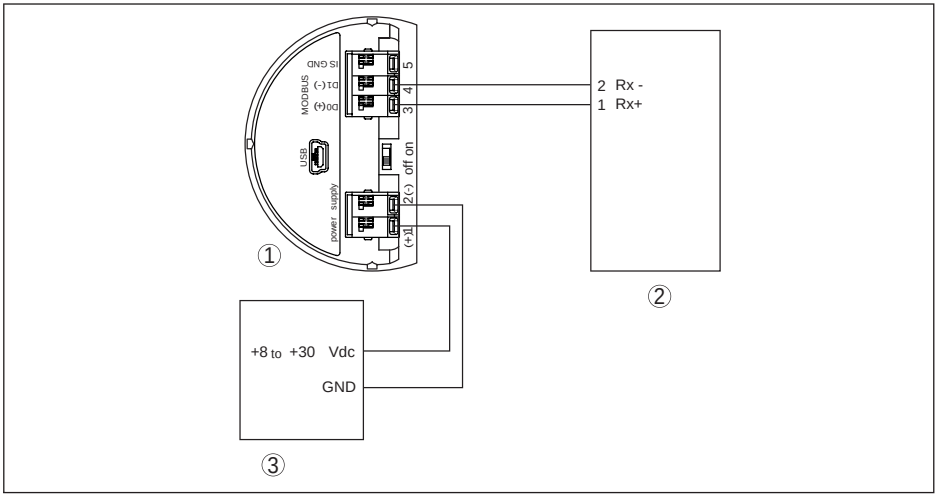


Fig. 36: Connection of VEGAFLEX 81 to RTU Thermo Electron Autopilot

1 VEGAFLEX 81
2 RTU Thermo Electron Autopilot
3 Voltage supply

Parameter

Parameter	Value
Baud Rate	9600
Floating Point Format Code	0
RTU Data Type	IEE Fit 2R
Input Register Base Number	0

The basic number of the input registers is always added to the input register address of VEGAFLEX 81.

Address 1300 must hence be entered as register address for 1300 for RTU Thermo Electron Autopilot.

Bristol ControlWave Micro

Wiring plan

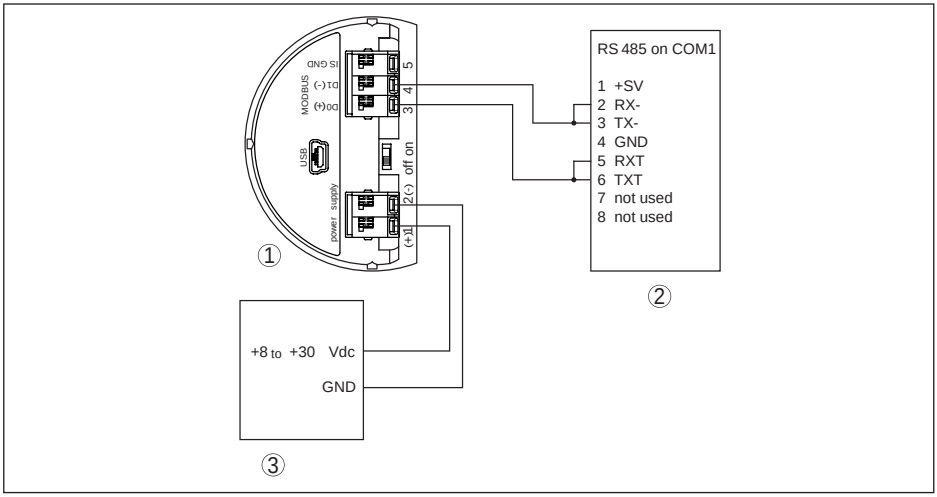


Fig. 37: Connection of VEGAFLEX 81 to RTU Bristol ControlWave Micro

1 VEGAFLEX 81
2 RTU Bristol ControlWave Micro
3 Voltage supply

Parameter

Parameter	Value
Baud Rate	9600
Floating Point Format Code	2 (FC4)
RTU Data Type	32-bit registers as 2 16-bit registers
Input Register Base Number	1

The basic number of the input registers is always added to the input register address of VEGAFLEX 81.

Address 1303 must hence be entered as register address for 1302 for RTU Bristol ControlWave Micro.

ScadaPack

Wiring plan

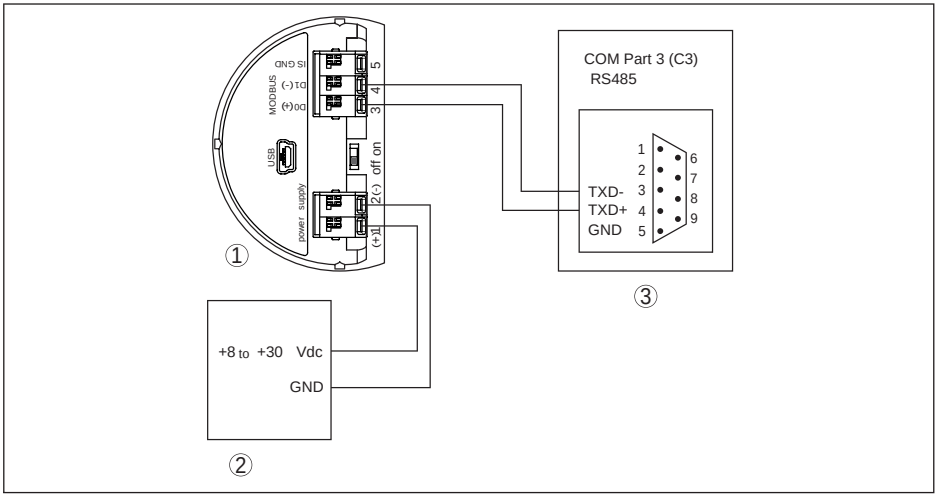


Fig. 38: Connection of VEGAFLEX 81 to RTU ScadaPack

1 VEGAFLEX 81
2 RTU ScadaPack
3 Voltage supply

Parameter

Parameter	Value
Baud Rate	9600
Floating Point Format Code	0
RTU Data Type	Floating Point
Input Register Base Number	30001

The basic number of the input registers is always added to the input register address of VEGAFLEX 81.

Address 31303 must hence be entered as register address for 1302 for RTU ScadaPack.

11.7 Dimensions

The following dimensional drawings represent only an extract of all possible versions. Detailed dimensional drawings can be downloaded at www.vega.com/downloads under "*Drawings*".

Housing

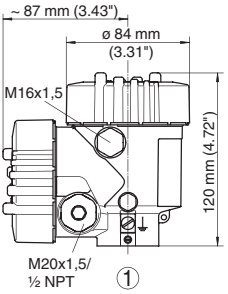


Fig. 39: Dimensions housing - with integrated indicating and adjustment module the housing is 9 mm/0.35 in higher

VEGAFLEX 81, coax version

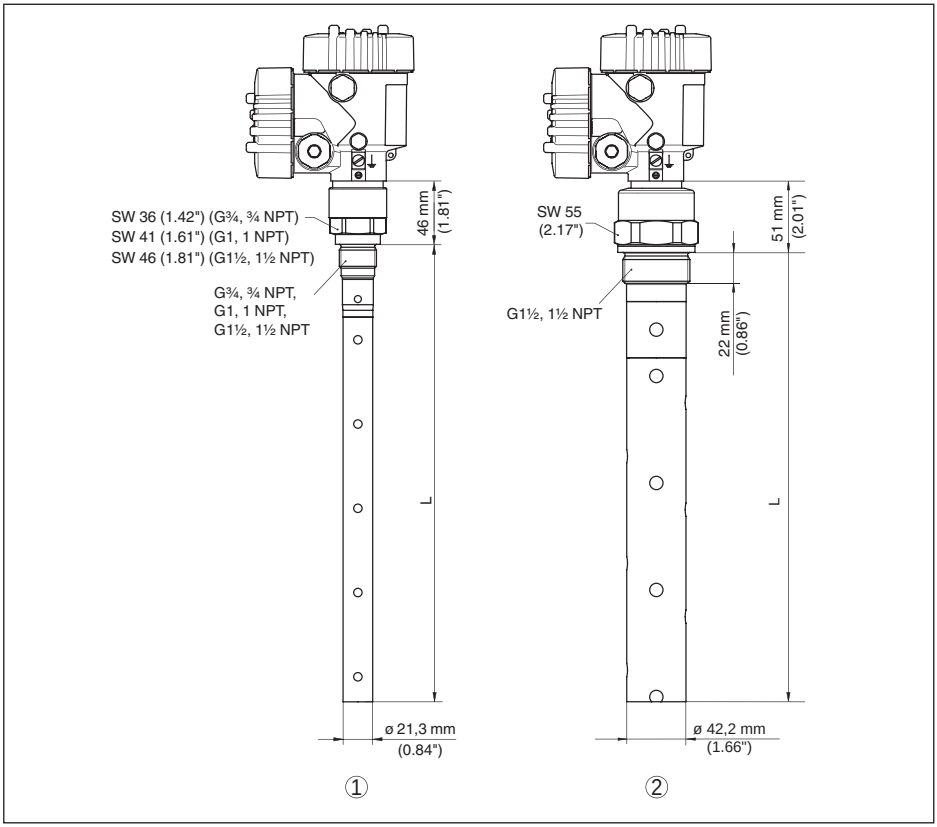


Fig. 40: VEGAFLEX 81, threaded version

L Sensor length, see chapter "Technical data"
1 Coaxial version ø 21.3 mm (0.839 in)
2 Coaxial version ø 42.2 mm (1.661 in)

11.8 Industrial property rights

Линии продукции фирмы ВЕГА защищаются по всему миру правами на интеллектуальную собственность. Дальнейшую информацию смотрите на сайте _____

VEGA系列产品在全球享有知识产权保护。

进一步信息请参见网站<_____>。

11.9 Trademark

All the brands as well as trade and company names used are property of their lawful proprietor/ originator.

INDEX

A
Accessories
- – External indicating and adjustment unit 11
- – External radio unit 11
- – Flanges 11
- – Indicating and adjustment module 10
- – Interface adapter 10
- – Protective cover 11

Adjustment
- – Max. adjustment 25
- – Min. adjustment 25, 26

Adjustment system 21
Application 23, 24
Application area 8

B
Backlight 31

C
Cable entry 16
Calibration date 37
Check signal 53
Connection procedure 17
Connection technology 16
Copy sensor settings 35
Current output, adjustment 29
Current output Min./Max. 29
Current output, size 28
Curve indication
- – Echo curve 32

D
Damping 26
Date/Time 34
DD (Device Description) 47
Default values 35

E
Echo curve memory 48
Echo curve of the setup 33
EDD (Enhanced Device Description) 47
Electronics compartment 18
Error messages 49
Event memory 48

F
Factory calibration date 37
False signal suppression 29
Fault rectification 53
Functional principle 8

G
Gas phase 24

H
HART address 36
HART variables 29

I
Inflowing medium 14
Installation position 13
Instrument version 37

K
Key function 21

L
Language 30
Linearisation 27
Lock operation 22

M
Main menu 21
Meas. reliability 32
Measured value indication 31
Measured value memory 48
Measurement error 54
Measurement loop name 22
Moisture 13

N
NAMUR NE 107
- – Failure 50
- – Function check 51
- – Maintenance 52
- – Out of specification 51

P
Packaging 10
Peak value 31, 32
PIN 34
Probe length 23
Probe type 36
Product type 23

R
Read out info 37
Repair 57
Replacement parts
- – Electronics module 11
- – Electronics module, Modbus 11

42283-EN-121112

– Indicating and adjustment module with heating 11
– Rod extension 12
– Spacer 12
Reset 34

S

Scaling measured value 27, 28
Sensor characteristics 37
Sensor status 31
Service hotline 56
Simulation 33
Special parameters 36
Status messages 49
Storage 10

T

Type label 7

U

Units 23

42283-EN-121112

Printing date:

All statements concerning scope of delivery, application, practical use and operating conditions of the sensors and processing systems correspond to the information available at the time of printing.
Subject to change without prior notice

© VEGA Grieshaber KG, Schiltach/Germany 2012

42283-EN-121112

VEGA Grieshaber KG
Am Hohenstein 113
77761 Schiltach
Germany

Phone +49 7836 50-0
Fax +49 7836 50-201
E-mail: info.de@vega.com
www.vega.com